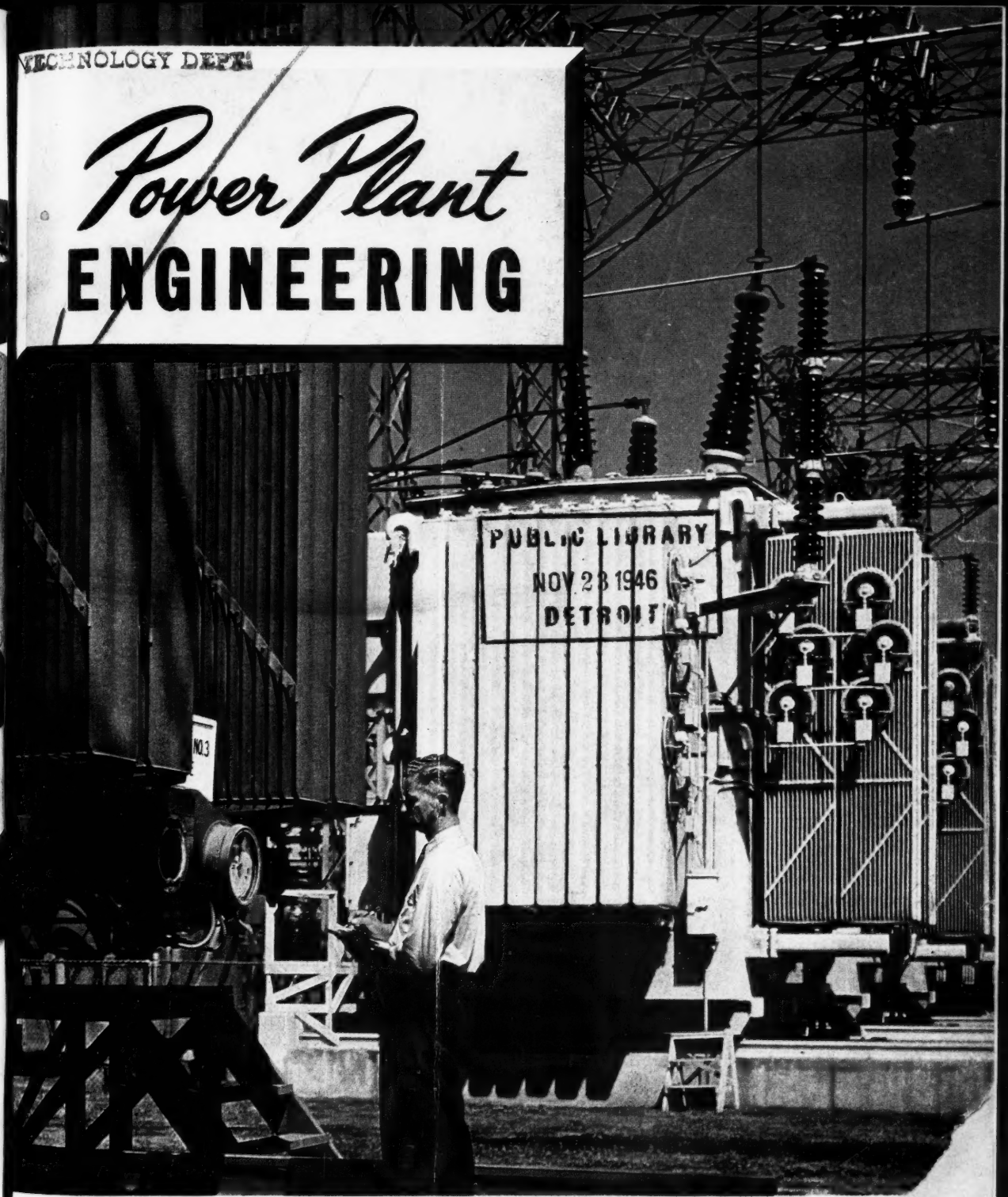
TECHNOLOGY DEPT.

Power Plant ENGINEERING



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THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY IND

VEMBER • 1946

Features

WHAT HAPPENED AT BIKINI • STEAM AND POW
LEE • NEW SPRINGDALE BOILER • TRANSFORM
INSTRUMENTS • 160,000,000-V BETATRON • CO
OF PLANT EQUIPMENT • • • • • CONTENTS

There's a lot of protection i

You will find Twin Strainers in most power plants as well as in process applications. They strain every liquid from gasoline to paint, in fact any liquid that will pass through a strainer. The amount of equipment they protect, rated either in capacity or in monetary value, cannot be computed but must be enormous. Occasionally we hear of Twin Strainers still faithfully serving after twenty or thirty years on the job.

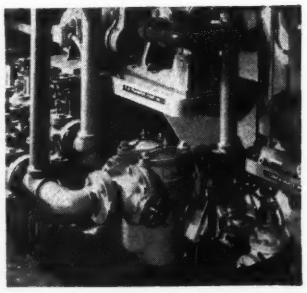
Straining is an Elliott specialty and has been for many years. Elliott Twin Strainers, Single Strainers, Oil Strainers, Self-Cleaning Strainers have long been favorites in their different fields wherever clear liquids are required.

If you have a straining problem, Elliott engineers can supply the right answer. Write us.

OTHER ELLIOTT STRAINERS *and* ACCESSORIES

TWIN OIL STRAINERS

Built on the Twin Strainer principle, adapted to the needs of oil line protection — both fuel and lube oil. Compact, sturdy, providing uninterrupted service. In sizes from 1" to 12".

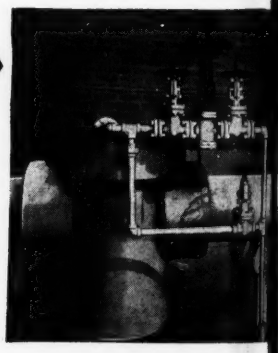


SINGLE STRAINERS

Where conditions do not require constant straining service, and the liquids to be strained do not contain too large a quantity of foreign material, single strainers will fill the need economically. The strainer basket is quickly accessible and easy to handle. Sizes from 1" to 24". Working pressures to 125 psi.

DESUPERHEATERS

Another Elliott specialty. Simple and reliable, they reduce superheat, or convert superheated to saturated steam. Construction prevents water being picked up and carried over with the steam. In several types covering a wide range of operating conditions.



• GAS TURBINES • GENERATORS

ATER HEATERS AND DEAERATORS

IFUGAL BLOWERS • TURBOCHARGERS FO

• STRAINERS • DESUPERHEATERS • FILTERS

TWIN STRAINERS

THEY STOP TROUBLE BEFORE IT STARTS

A lot of what might have been bad trouble is caught in the strainer basket being withdrawn for dumping. These baskets are available in many sized meshes, for all straining needs. They are usually large enough in relation to pipe size, to present minimum impedance to liquid flow.

THEIR GUARD NEVER RELAXES

One of the cylinders is always working. It is not necessary to clean a cylinder immediately after it becomes fouled. The flow can be diverted to the twin cylinder and the fouled cylinder cleaned when convenient.

THEY ARE EASILY CLEANED

By backing off a few nuts and removing the clamping bars, the cover can be raised and the basket lifted out for dumping. The entire operation need take only a few minutes. The need for cleaning is usually indicated by a pressure gage, the building up of pressure beyond a standard point indicating that the basket mesh is becoming clogged with foreign matter.

GATE VALVES SWITCH THE FLOW

from one straining chamber to the other. These valves each have a single disc which travels between two seats, sealing off one chamber while opening the other for duty. Disc brushes off solid or foreign material which may cling to valve seat, assures against scoring or leakage. In some sizes of Twin Strainers the two valves are linked by a drive chain running over sprockets, thus turn simultaneously. In larger sizes they can be motor-driven. Twin Strainers are built in sizes from 2" to 42".

STREAM-LINED FLOW OF LIQUID

is provided by the avoidance of sharp turns in channels leading to and from straining chambers. Smooth easy curves are the rule, with generous dimensions in channels and straining chambers.

HEAVY, SOLID CONSTRUCTION

Twin Strainers have always been of substantial cast construction, heavy and essentially sturdy. The three elements solidly bolted together are the center section containing the twin straining chambers, and the two end sections carrying valves. Valve mechanisms are easily reached through large hand holes.

A-289

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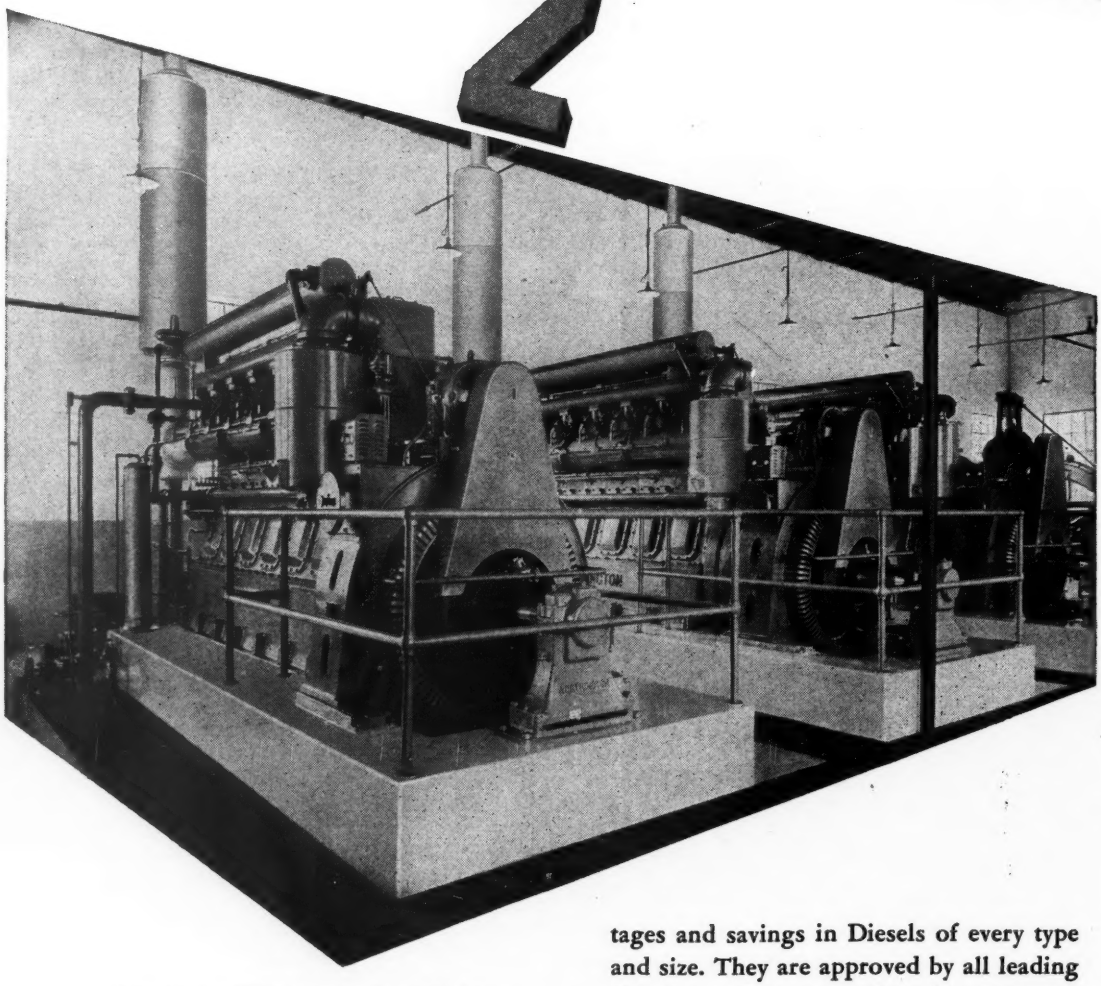
TIME TO TAKE A

MAKE

2 IMPORTANT SAVINGS IN DIESEL OPERATION



OR low operating cost, lubricate your Diesels with *Texaco Ursa Oils.* You'll *save on fuel, save on maintenance.*

Texaco Ursa Oils stand up in the severest service . . . keep engines clean . . . assure longer life for bearings, liners, rings and pistons. *Ursa Oils* promote maximum engine efficiency . . . dependable, full-power output . . . minimum expense for fuel and maintenance.

There are *Ursa Oils* to assure these advantages and savings in Diesels of every type and size. They are approved by all leading Diesel manufacturers and used by operators the world over. In fact, because of their effectiveness—

More stationary Diesel hp. in the U.S. is lubricated with Texaco than with any other brand.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2300 Texaco distributing plants in the 48 States, or write The Texas Company, 135 E. 42nd St., New York 17, N.Y.

TEXACO Ursa Oils FOR ALL DIESEL ENGINES

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November, 1946

VOLUME 50—NUMBER 11

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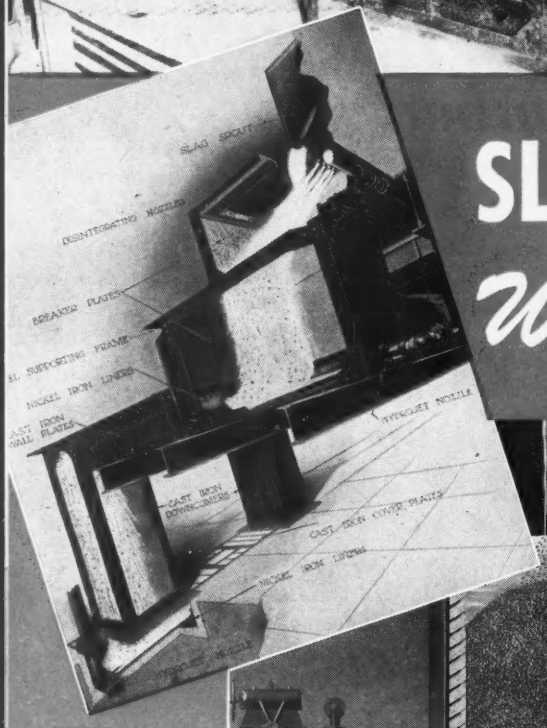
A DETAILED and well-illustrated review of the war years at Kellog's Jersey City plant is given in Issue No. 3 of *The Kellogram*. In this issue on overall plant efficiency and economy. Whether OIL COOLERS are an auxiliary item of equipment whose proper maintenance has an important bear-

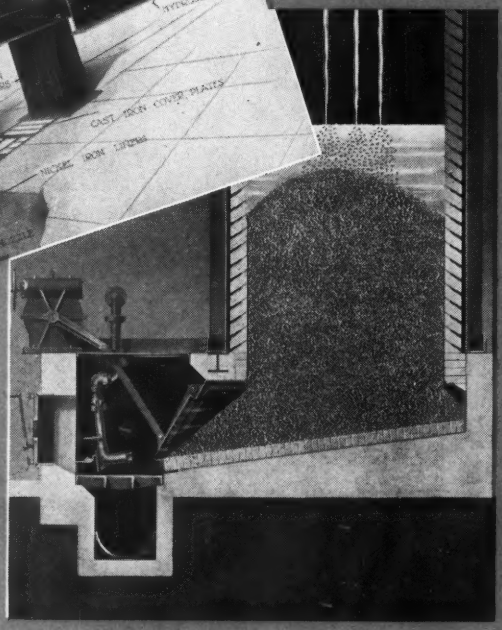
BEFORE ▶

◀ AFTER

SLAG ASH HANDLING

Was Once a Problem





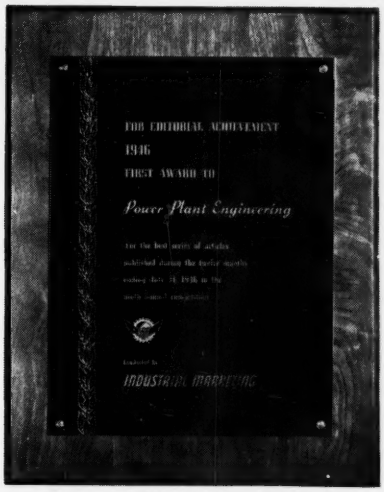
ABOVE—
Typical Hydrojet System for Intermittent Slag Tap Furnaces. This is the system shown in the above installation photo which was made in the same plant as photo in upper right.

RIGHT—
Typical Hydrojet Ash Handling System for modern continuous slagging furnaces.

Slag ash used to be tapped from the furnace an allowed to flow onto the basement floor; then, aft it cooled, workmen dug it out with pick and shov and loaded it into small cars. This was in 1927, an then (as now) we were called in to solve the ne and unusual ash handling problem. With the assi tance of the "pioneering-minded" engineers at th utility power plant, who on reading this will know whom we mean, we succeeded in solving this proble with a Hydrojet System. After this success on th Intermittent Slag Tap Furnace we were naturall called in years later when the Continuous Slaggin Furnace presented new problems. Again we solve them, with the cooperation of some of the nation' leading engineers. Catalogs sent on request; an remember, "As always, A-S-H will pioneer in as and dust handling."

ALLEN-SHERMAN-HOFF CO., 233 S. 15th St., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

Front Lines



The silver plaque we won

Andy Kramer just after his return from the Bikini tests

WITH WHAT WE hope is the correct mixture of modesty and pride, we call your attention to the first prize plaque awarded to *Power Plant Engineering* in the 9th annual editorial competition held this year by Industrial Marketing magazine of Chicago. In this competition, 157 of the leading technical and trade magazines of the country submitted 443 entries. The first prize to *Power Plant Engineering* was for the best series of articles on a single theme of importance and interest in its field. The series was that on atomic energy, beginning in our September 1945 issue and still continuing, as you readers know, in our now-famous Atomics section.

In beginning this series of articles as soon as the data on the atomic bomb had been made public, we felt it was incumbent upon all engineers to learn as much as possible about this new and rather terrifying discovery. The general non-engineering public, we felt, would look to engineers and technicians of all types for help in understanding it. The engineer was accustomed to the type of thinking required to give this help. Moreover, the potentiality of atomic energy as a source of power placed it right on the doorsteps of you readers.

Right from the beginning, there was one logical man on our staff to do this job—Andrew W. Kramer, our managing editor—Andy to us. For years he has been a radio "ham," electrical engineer, student of modern science, interpreter of electrical and electronic fundamentals. Twenty years ago, in his famous Electricity—What It Is and How It Acts series, later published in book form, he explained in non-mathematical terms the fundamental conceptions of matter and energy underlying modern science. His authoritative recent book on Elementary Electronic Engineering and a forthcoming book on Industrial Electronics present the latest data in that field. Consequently, because of his thorough understanding of science itself and his ability to write about it clearly and simply, he was in a position to interpret the atomic energy development to *Power Plant Engineering* readers in a way that has attracted wide attention. Hundreds of requests have been received for reprints of his atomic energy articles.

Finally, when the correspondents were selected by the Joint Task Force to report to the American public on the Bikini atomic bomb tests, Andy was one of the few men named to represent the technical press of the country (the majority represented newspapers).

As a result of all this, we won first prize for editorial excellence in a contest in which there is some very high-grade competition indeed.

Andy Kramer is now taking to the lecture platform to explain to engineers and interested laymen details of importance and interest resulting from the Bikini tests; and to show his own pictures and the official pictures of the tests just becoming available. On page 84 of this issue, you will find his engineering analysis of the tests in What Happened at Bikini.

So we regard this recognition of both *Power Plant Engineering* and Andy with pride. It stimulates us to still further efforts. The development of atomic energy has barely begun. It must go forward in peaceful channels; there is no alternative. Andy and the rest of us will do all we can to keep you in step with it.

the war. Especially interesting in this account are the details shown of heat exchangers, condensers, pressure vessels from 5 to 500,000 pounds in weight, piping for Naval vessels and the like.

A BRILLIANT LUSTER can now be imparted to silver by an electrolytic treatment. Thus silver becomes one more of the fast growing group of metals to receive this treatment. The method is "Electroplating in reverse." A current opposite in direction to that employed for ordinary plating removes metal preferentially from the high spots to produce a mirror-smooth surface. It replaces manual and mechanical buffing of silver or silver plated objects. This electropolishing technique in general, says the *Industrial Bulletin*, is a relatively new finishing procedure which has developed rapidly during the last ten years.

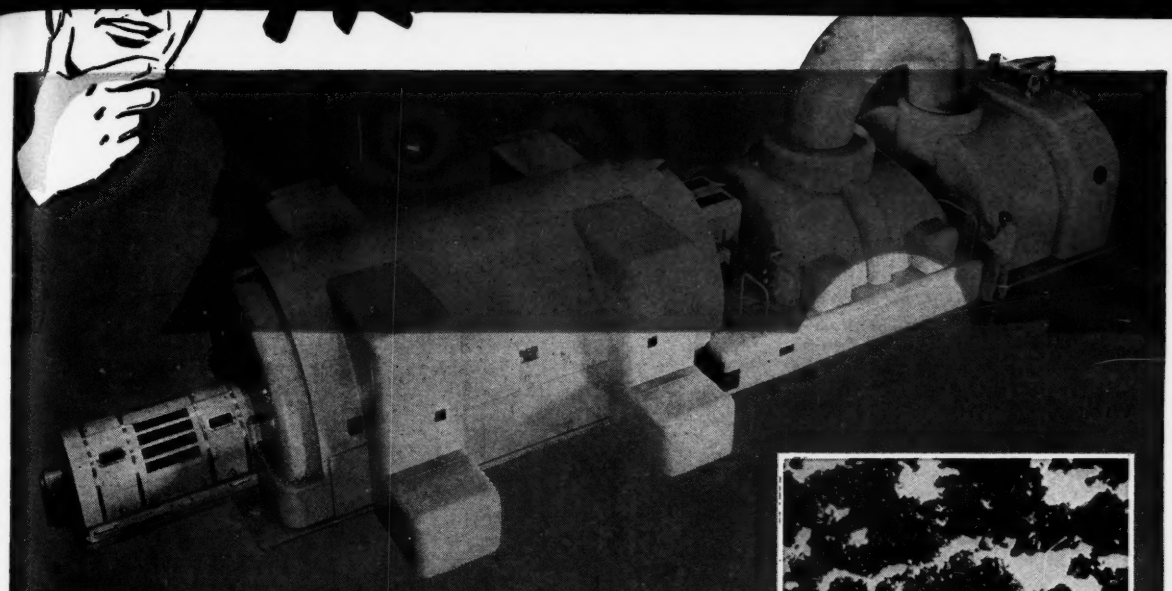
THIRD EDITION of the popular SMA Information Manual containing a complete listing of all manufacturer and associate members and other widely-used reference material on the Association and the stoker industry, is being published by the Stoker Manufacturers Association.

HOW LOUD does a mouse squeak when given an electric shock in the tail? If you don't think the answer to that is of any importance whatever, you had better guess again. The Wellcome Research Laboratories, by measuring the amount of electrical energy needed to shock a mouse into vocalizing while he is under the influence of certain pain-killing drugs, has developed a reliable measurement of the potency of the drugs. All types of pain-killers can be measured by this test including alcohol and aspirin. The established standard for comparison is morphine. This was only one of the many interesting developments discussed recently in Chicago at the 110th Annual Meeting of the American Chemical Society. Sawdust-derived vitamin tablets, snow-white potato chips, plumper oysters, cinnamon from waste oat hulls and a sure-fire freckle remover—all are in store for Americans of the future. One of the reports that received most attention in the newspapers is the research by scientists of the Raymond Laboratories, who describe how new methods of determining the cystine content of human hair at various stages of the permanent waving process will enable every woman, even bleached blondes, to have curls.

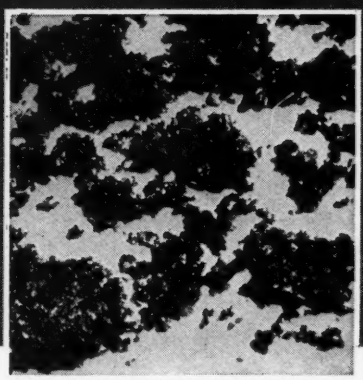
[illegible] standards. Their efficiency will be impaired after a period of time by the formation of sludge and carbonized deposits. Consequently, regular cleaning is necessary if the coolers are to operate efficiently. How this can be done by the use of various Oakite compounds is described in *Oakite News Service*, July-August, 1946, Volume 30, Nos. 7-8.

KNOWLEDGE that the acoustic nerve of the human being originates in the same part of the brain as the optic nerve has made possible a system of two-way communication over one channel. By infrasonic switching, two circuits on a single channel are alternately interrupted, freeing the channel for use, one circuit at a time, for recurring intervals. The interruptions in conversation are inaudible because of an auditory effect comparable to persistence of vision—*The Ohmite News*.

PRODUCTION of cheap oxygen is one of the chief economic factors that may lead to new methods of synthesizing gasoline from coal or natural gas. We have referred to this before, particularly in connection with the idea of burning coal with pure oxygen instead of air. With present oxygen costs of 12 to 15 cents per thousand cubic feet, this would be out of the question. However, the possibility of using oxygen for the complete gasification of coal in the production of gasoline from natural gas is not too remote. P. C. Keith, president of Hydrocarbon Research, Inc., estimates that oxygen can be produced as a part of his process for 4.8 cents per thousand cubic feet. This would be low enough to permit competitive production of gasoline from natural gas and later from coal. Mr. Keith also refers to a process now being developed for complete gasification of coal by use of oxygen, followed by production of a high methane gas of nearly 1000 Btu per cubic foot, which might eventually compete with natural gas delivered by pipe line. Hydrocarbon Research, Inc. is engineering a $15,000,000 plant for the synthesis of gasoline from natural gas, to be located at Brownsville, Texas. On the basis of figures now available, 6-cent gasoline from $2.00-per-ton coal is not more than 2 or 3 years off, according to Mr. Keith. This process would be a combination of complete gasification of coal with oxygen and steam, and synthesis conversion of the gases to liquid products.



DON'T "INFECT" NEW TURBINE OIL BY PUTTING IT IN A DIRTY SYSTEM!



Photograph of sediment consisting of rust particles, chips of metal, carbon and gum removed from the lube oil system of a large steam turbine. Proper cleaning of a turbine's lube oil system before the initial charge of lubricating oil is installed can save serious trouble.

SHELL CLEANING PROCEDURE

makes it easy—makes it sure!

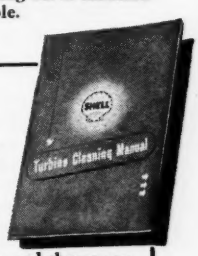
• A small amount of sludge and dirty oil acts on clean, new oil like a rampaging disease—can shorten its life 50 to 75%. Chemists call it the auto-catalytic effect—sludge, metal particles and rust acting as catalysts to hasten the oxidation of new oil.

Before you add that next batch of make-up oil to your system, be sure to get details about Shell's Turbo Cleaner and the Shell Cleaning Procedure. *You may decide to take a fresh start.*

Remember, too, this procedure should be followed before putting the first charge of oil in *new equipment.* As insurance, it's cheap enough to know that your turbine is free of contaminants such as slushing compound, run-in oil, and metal chips.

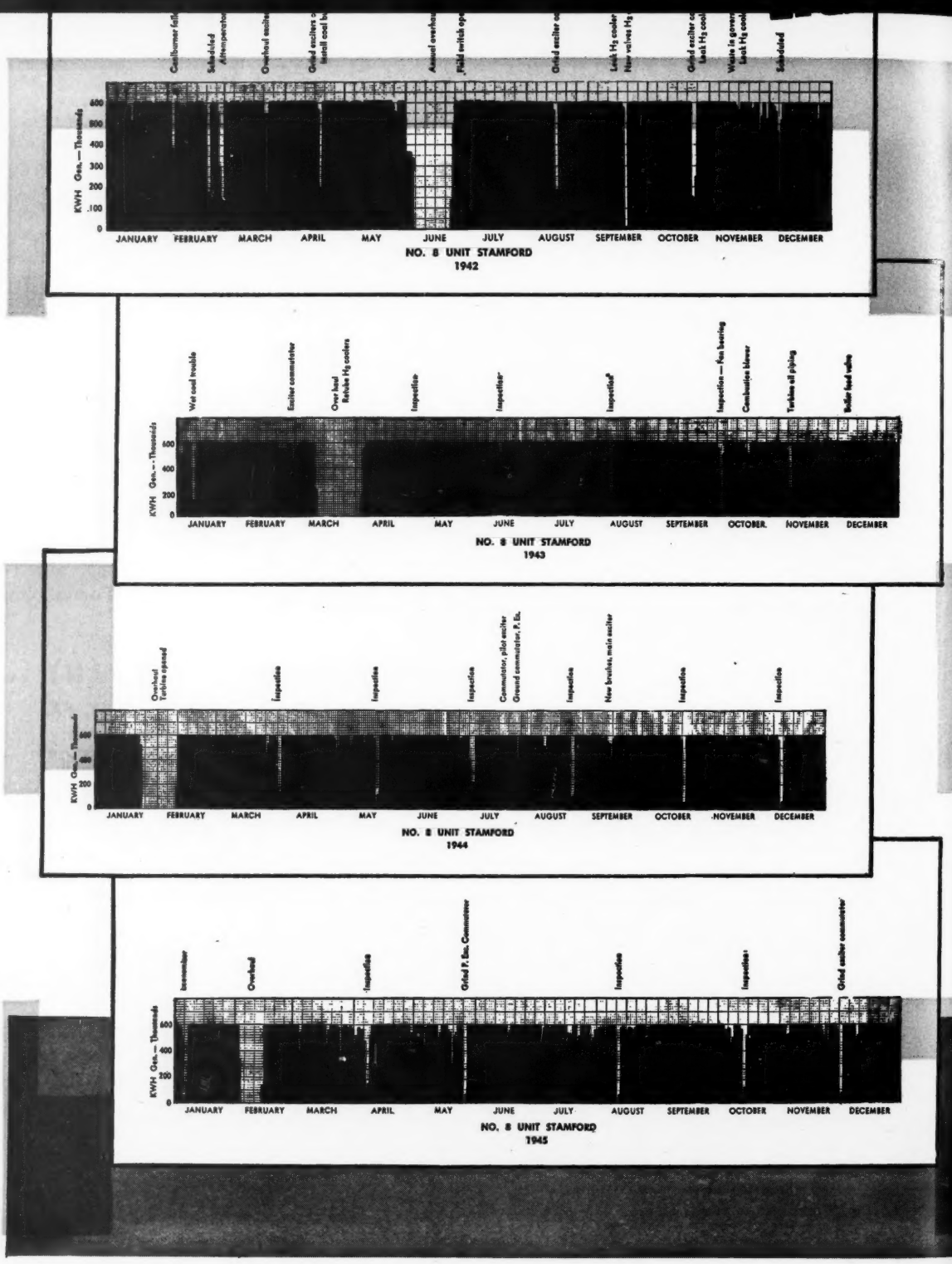
Call the Shell Lubrication Engineer, or write for your copy of the Turbine Cleaning Manual. Shell Oil Company, Incorporated, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California.

SEND FOR THIS BOOKLET NOW!



Every turbine owner and operator should have a copy. It contains full details on the Shell Turbo Cleaner and Shell Cleaning Procedure, and shows you how to get peak efficiency, lower operating costs.

SHELL TURBO OIL



YARWAY STEAM PLANT EQUIPMENT

...ICUT POWER CO.
STAMFORD, CONN.

...JECTIVE: To balance installation costs, maintenance expense, and thermal efficiency to give the lowest over-all cost of electrical energy. . . .
—from statement of engineers BEFORE installation.

APPROACH: Addition of a new base-load unit consisting of a 25,000-kw. turbine and a 250,000 lb. per hour B&W Radiant Boiler.

% OF TIME ON LINE: Here is the "on-the-line" record of this unit for complete years since its installation:

1942	90.9	1944	92.0
1943	89.9	1945	93.3
Four-year average			91.5

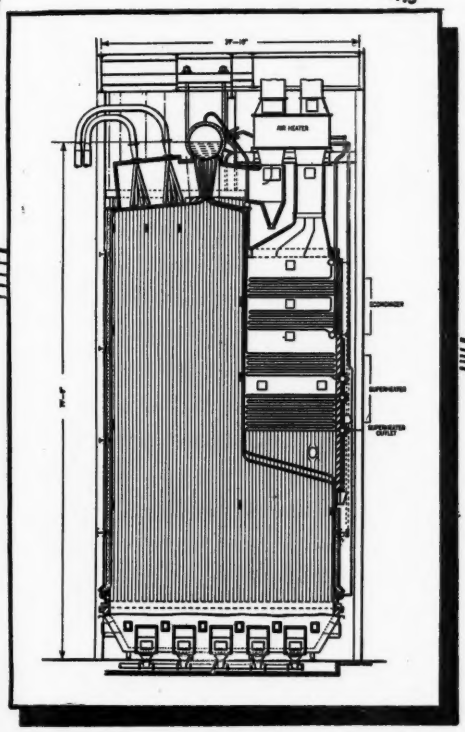
CAPACITY FACTOR: 1942 .... 89.2 1944 .... 90.4
1943 .... 87.9 1945 .... 90.0
Four-year average 89.4

OUTAGE TIME CHARGEABLE TO BOILERS: One-tenth of one per cent since put into operation in October 1941.

CONDITION: No slag around burners, on side or rear walls in burner area, or in superheater. Slag formations elsewhere negligible or easily removed without shutdown. Original superheater tubes still in service. Turbines have never required cleaning and have shown no deposits at normal inspection periods.

SATISFACTION: The performance record of B&W boilers at Stamford is further evidence of the dependability, continuity of operation and low ultimate cost that is built into all B&W units, and in the words of engineers of the Connecticut Power Co. after four years' operating experience with this unit: "A conservatively designed unit conservatively run pays dividends."

Also at Stamford are four 600 hp. B&W Boilers and two 180,000 lb. per hr. B&W Boilers.



B&W Radiant Boiler installed in Stamford Station of Connecticut Power Company in 1941. Maximum continuous steam capacity—250,000 lb. per hr. at 975 psi and 915F. Designed for vertical firing with either pulverized coal or oil.

B&W

Water-Tube Boilers, for Stationary Power Plants, Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes

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Dependable combustion control for small plants with the

Simplified

Hagan system

Small steam plants need an accurate, dependable, rugged automatic combustion control system at moderate cost.

Hundreds of such plants have found the answer in the Hagan *simplified* system, consisting essentially of a Hagan Master Regulator and one or more Hagan Furnace Draft Controllers. These are part of the regular line of Hagan equipment, meeting exactly the same standards of engineering and construction as the Hagan equipment used in the largest power plants. Reduction in cost is achieved by eliminating refinements in the Hagan system which are not essential in small plants.

These simplified Hagan Automatic Combustion Control systems have a long record of satisfactory service.

One mid-western industrial plant installed this equipment on its first two boilers, back in 1929. For 15 years the Master Regulator was in continuous operation except for a few week ends when it was shut down for repacking the cylinder. From time to time, additional boilers were connected to the system, but the same Master Regulator served all of them.

Finally, in 1944, still more boilers were added and the plant changed over to the Hagan panel type of control.

The Master Regulator was no longer needed—but its years of service were not ended. A nearby company needed a control system for an auxiliary boiler which operated at a lower pressure than the others and hence could not be linked to the existing control system. Sale to this company was arranged, and after repacking and fitting with new linkage pins, this 15-year-old Hagan Master Regulator was again at work—and is giving perfect service.

Our engineers will be glad to show you how the Hagan *simplified* automatic combustion control will cut your fuel costs. Write for full information.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

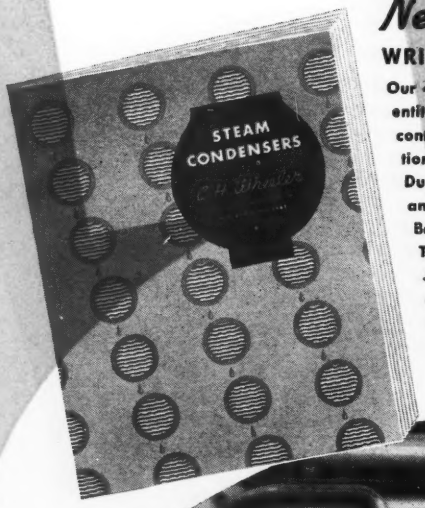
All Hagan control systems are designed on the principle that *control* and *metering* are separate functions. Only when these functions are kept independent of each other can control equipment have the dependability, ruggedness, sensitivity and speed of response that are essential for the proper operation of Automatic Combustion Control systems.

HAGAN
HALL
BUROMIN
CALGON

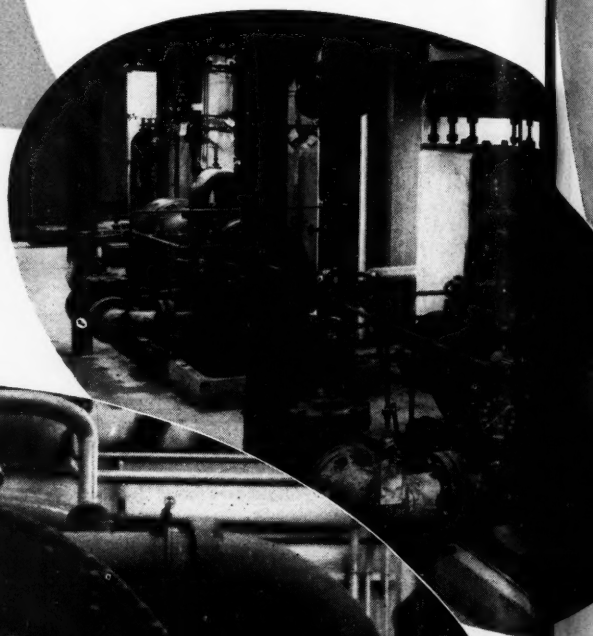
New Catalog

WRITE FOR IT TODAY

Our 44 page Catalog No. 1461 entitled "Steam Condensers" contains pictures and descriptions of our complete line of Dual Bank Surface Condensers and Jet Condensers of both Barometric and Low Level Types; also includes Steam Jet Air Ejectors, Pumps, etc., plus many pages of useful engineering information, tables, charts, etc.



Installation of two, 3-stage Condensate Pumps of our special design for this service. These pumps are fully described in our new 44 page Condenser Catalog.



C. H. Wheeler Dual Bank Surface Condenser with divided water box, which permits half of the condenser to operate while the other half is being cleaned. C. H. Wheeler special design water circulating pumps at left and right in fore-

Steam Condensers – Cooling Towers
and a Complete Line of Accessories

We don't make "almost everything" for a steam power plant and we don't make just one thing; however, we do specialize in one group of allied products and have been doing so for over fifty years. We feel that our range makes us large enough to maintain a competent staff and an adequate shop for the largest jobs, yet not too big to give careful, personal attention to the small jobs. Our steam condensers have tubes arranged in a "Dual Bank" design, which gives deep penetration for the entering steam and produces condensate temperatures corresponding to the vacuum. They are built in all sizes and types. We built the first condenser to which the steam jet air ejector was successfully applied back in 1916 and have been building ejectors, now known as Tubejet, ever since. Write for our new 44 page catalog featuring our Steam Condensers and allied products.

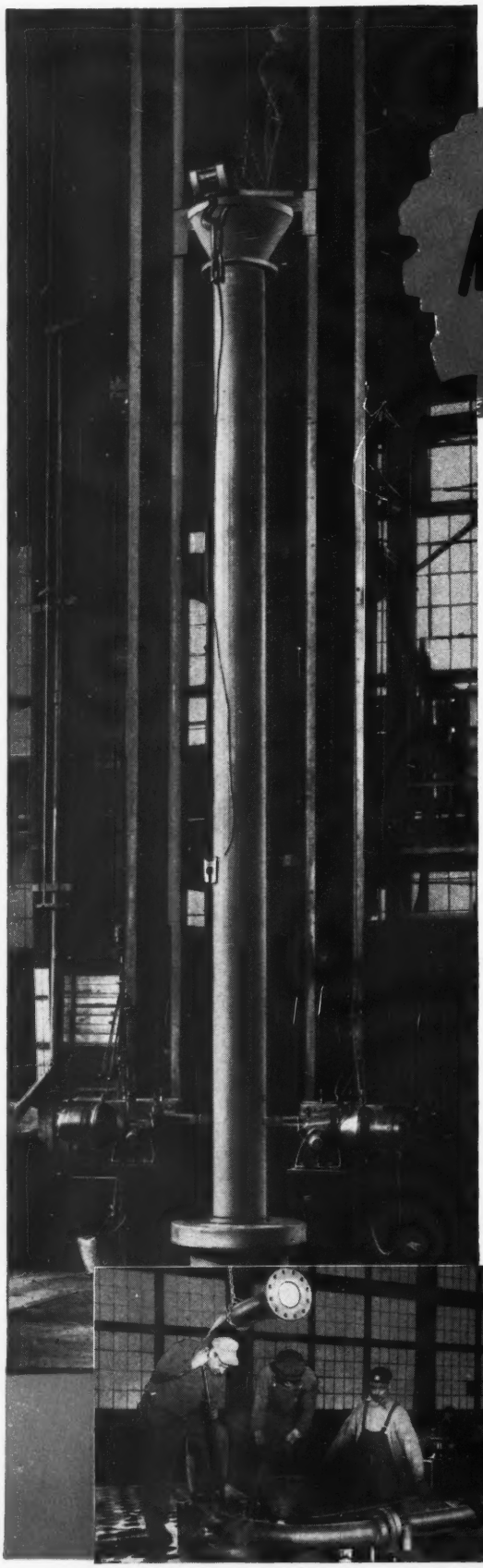
C. H. WHEELER MANUFACTURING CO.

1502 SEDGLEY AVENUE, PHILADELPHIA 32, PA.

REPRESENTATIVES IN MOST PRINCIPAL CITIES

Tubejet Steam Jet Air Ejector with Surface Type Inter-After Condenser, as installed in a central station.

Water Cooling Towers of both Induced and Forced Draft Types, correctly engineered for any climatic condition. Send for our 20 page Catalog No. 145.



MAINTAINING $\frac{\pi d^2}{4}$ during PIPE BENDING

Typical of the specialized equipment developed by Grinnell for prefabricating piping is this sand filling and packing machine. By solidly packing the pipe with special sand before heating and bending, the possibility of flattening or buckling and consequent constriction of full flow is eliminated. Pipe can be bent accurately to detailed drawing.

By employing these specialized machines and highly skilled techniques, Grinnell assures the exact control of measurements and quality so important to correct alignment and dependable performance of prefabricated piping assemblies.

Complete prefabrication facilities backed by metallurgical research, engineering knowledge and long experience are responsible for the type of work that has established Grinnell as the leading source "whenever piping is involved".

Vibrators packing sand in pipe.

Bending pipe to detailed drawing.

GRINNELL COMPANY, INC.
Executive Offices, Providence 1, R. I.

Pipe Fabrication Plants:
Providence, R. I. Atlanta, Ga. Warren, Ohio

GRINNELL

FOUNDED 1850

WHENEVER PIPING IS INVOLVED

Photo courtesy Allis-Chalmers Mfg. Co.

BRIDGEPORT CONDENSER TUBE ALLOYS

solve many corrosion problems

Corrosion is the bugbear of industry. Oil refining, chemical processing, and synthetic products manufacture are probably more plagued with it than other industries because they constantly deal with corrosive solutions at elevated temperatures.

Bridgeport carries on a consistent program of corrosion research in the laboratory and in the field so as to be more helpful in recommending the tube alloy or the proper Duplex Tube combination which will give lasting service.

We recognize the principle of continuous operation and know that modern corrosion resisting copper-base alloys in the form of condenser and heat exchanger tubing, general piping and refrigeration systems are greatly helping to reduce the waste of costly interruptions and constant maintenance expense.

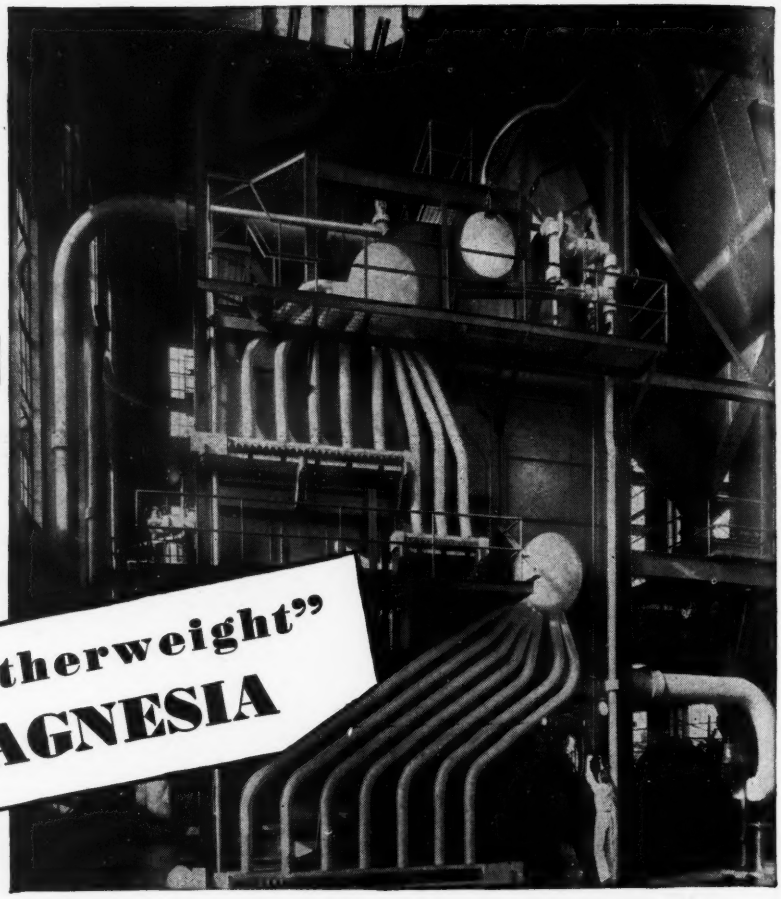
Bridgeport has a dozen fine alloys to choose from and can render aid through its Technical Service Department. Write today for your copy of the 112-page Condenser Tube Manual and the Duplex Tubing Technical Bulletin.

"Bridgeport" BRASS CO.

BRIDGEPORT BRASS COMPANY
BRIDGEPORT 2, CONN. • *Established 1865*

Condenser and Heat Exchanger Tubing
BRIDGEPORT BRASS

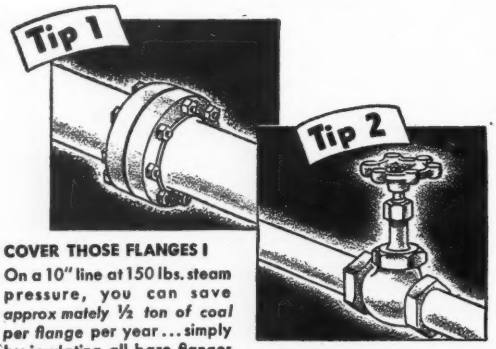
"Featherweight" 85% Magnesia application in a large distillery, where temperatures must be accurately controlled... showing insulated drum ends, water wall piping and headers.



How to S-T-R-E-T-C-H your fuel supply

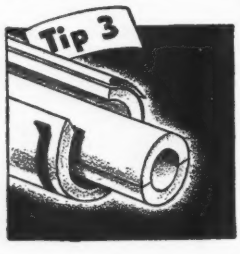
K&M "Featherweight" 85% MAGNESIA

3 TIPS TO HELP YOU SAVE FUEL!



COVER THOSE FLANGES!
On a 10" line at 150 lbs. steam pressure, you can save *approximately ½ ton of coal per flange* per year... simply by insulating all bare flanges with "Featherweight!"

COVER THESE, TOO!
Similarly, gain further fuel savings by covering all valves, elbows and other fittings in the steam lines.



SPECIFY THE BEST
To be sure of maximum fuel efficiency, minimum heat loss, be sure all lines are covered with "Featherweight" 85% Magnesia.

With coal so hard to get these days... and *all* fuel a costly item... it's more important than ever to squeeze that last BTU out of your fuel supply.

You can be sure of minimum heat loss and low fuel consumption if you standardize on K&M "Featherweight" 85% Magnesia insulation. Designed for pipes carrying up to 600°F., "Featherweight"—under various service conditions—has proved to be the most efficient insulation of the moulded type. It is light in weight, fire-proof and extremely durable.

Send for full technical information about "Featherweight"... and find out how it can help you gain more power with less fuel, at less cost.

Nature made Asbestos...
Keasbey & Mattison has been making it serve mankind since 1873.

K&M best in asbestos

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

FOR TODAY'S TOUGHER JOBS, HERE'S A NEW TOUGHER MOTOR

WHERE IT'S WET Wet weather doesn't bother the new totally-enclosed Tri-Clad motor. Neither do frequent "washdowns" in food. plants.

WHERE IT'S CORROSIVE Acids, alkalis, and fumes are kept out of these new Tri-Clads. Cast-iron enclosures are corrosion-resistant, extra strong.

WHERE IT'S DIRTY Dirt and dust can't get into these Tri-Clads to shorten their life. Smooth surfaces are convenient to clean.

WHERE IRON DUST FLIES Harmful iron dust and metal filings can't get past the inner wall. Bearings are protected from dust.

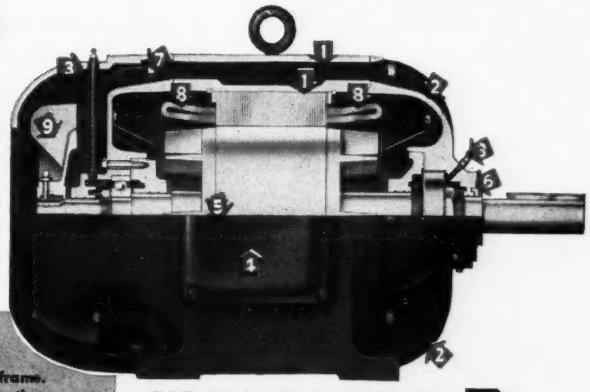
WHERE QUARTERS ARE CLOSE When space is limited for a totally enclosed motor, you'll like these trim, compact new Tri-Clads.

WHERE EXPLOSION HAZARDS EXIST The new Tri-Clad motors are available in explosion-proof constructions where needed.

THE G-E TRI-CLAD TOTALLY ENCLOSED MOTOR

(1 TO 1000 HP)

In 1940 you welcomed the Tri-Clad open motor with it's *extra protection features*. More Tri-Clads have since gone into service than any other integral-horsepower motor. Now G.E. is ready with a new line of tough, totally enclosed Tri-Clad motors for use in adverse atmospheres. *We believe they are industry's most dependable motors*. Their longer life and lower maintenance will make them a sound investment on almost every job. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



10-POINT PROTECTION

1. A cast-iron, double-wall frame completely encloses and protects the windings and punchings.
2. Corrosion-resistant cast-iron end shields are machined to provide a tight seal, and protect the motor from dust, dirt, and moisture. Primer and finish coat of Glyptal* varnish affords high rust-resistance.
3. A pressure-relief greasing system, which can be packed with long-life lubricant, protects the bearings.
4. The cast-iron conduit box is diagonally split for easy wiring. Boxes are independently explosion-proof on Class I motors.
5. Nonshrinking compound around motor leads protects motor interiors from dust and moisture at the point where leads pass through the frame.
6. Rotating labyrinth seal further protects motor interior from damage by foreign matter.
7. Large air passages provide adequate protection from overheating. They're easy to keep clean and open, too.
8. Modern, "ageless" insulation treatment includes windings of *Formex magnet wire.
9. The powerful external fan is removable to simplify maintenance; nonsparking type in explosion-proof motors.
10. Individual dynamic balance of rotors and external fans protects against vibration hazards, even under severe operating conditions.

*Trade-mark Reg. U. S. Pat. Off.

FOR THE COMPLETE STORY

Apparatus Department, Section H750-278C
General Electric Company
Schenectady 5, N. Y.

☐ Please send me GEA-4400, which describes the new Tri-Clad totally enclosed motors.

☐ Please send me GEA-4131, "Motors and Control for Hazardous Locations."

NAME.....

COMPANY.....

ADDRESS.....

8690

GENERAL ELECTRIC

low cost steam CONTRIBUTES TO

BRUCE J. CARL
MAYOR

D. ELROW CRANE
CHIEF ENGINEER

ERNEST J. RAY
SECRETARY

City of Columbia
Water and Light Department
Columbia, Missouri

FOR THE PEOPLE
BY THE PEOPLE

MAXIMUM SERVICE
MINIMUM RATES

September 24, 1946

Hoffman Combustion Engineering Co.
710 Marquette Building
Detroit, Michigan

Gentlemen:

In 1938 we purchased our first FIRITE spreader type stoker from you to install under a Springfield 60,000 pound per hour steam generator. Since the installation it has seen service better than 90% of the time.

The rest of the plant consisted of five (5) other boilers which were being fired with chain grate stokers when the above mentioned purchase was made.

I might add that we were so well pleased with the first installation that we purchased two (2) additional FIRITE spreader type stokers, one of which is in the process of installation at this time and the third installation to be completed the first half of 1947.

I can heartily recommend this equipment to be used with any steam generator at any location. Come down and look it over for yourself.

Yours very truly,

D. Elrow Crane

D. Elrow Crane,
Superintendent

DEC/mlh

The Educational Center of Missouri

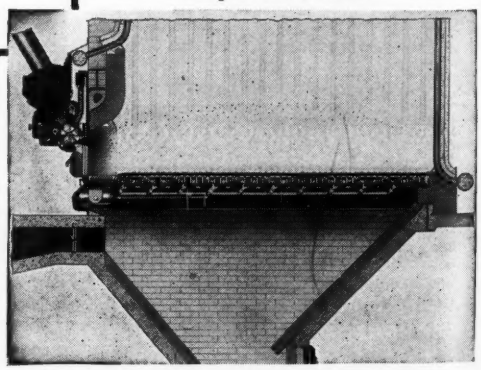
CITY OF COLUMBIA Missouri in seven years increases output 130% to 20,640,000 KWH at a coal increase of only 16%

D. ELROW CRANE
Superintendent

July 27, 1946
1¼" x 0 Washed Screenings As Fired

Moisture . . 9.26	Ash 7.37
Vol M . . . 36.95	Sul 3.28
F. C. 46.42	B. T. U. . . 11,617

Ash Fusion 1900-2000°F



Power dumping grates under Boilers No. 1 and 2

HOFFMAN COMBUSTION

WORKS AT: FAIRMONT, WEST VIRGINIA
DETROIT, MICHIGAN

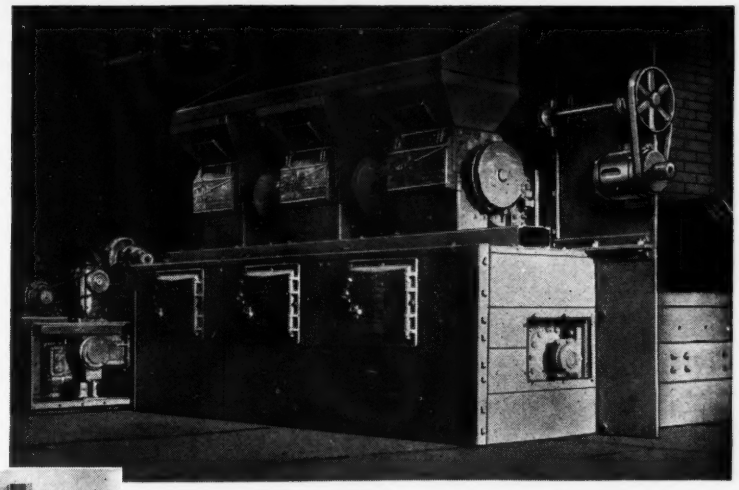
EARNING POWER of municipal plant

HOFFMAN

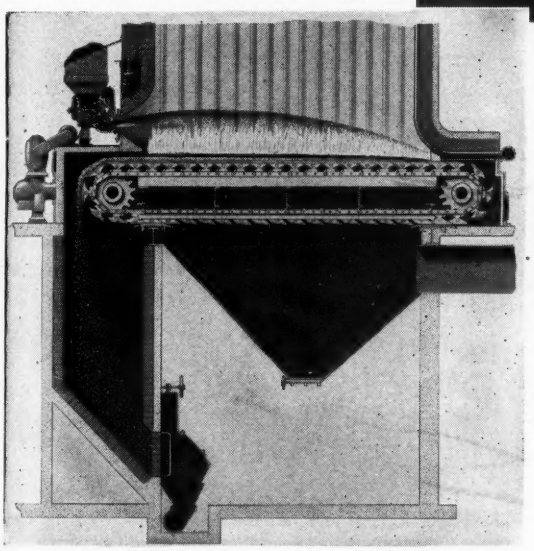
Firite SPREADER

STOKERS

with power dumping grates and continuous discharge grates



3/4 elevation Type 3C-CAD Hoffman Firite Stoker



Continuous Ash Discharge grates under Boiler No. 3

Burns & McDonnell Engineering Co.

Consulting Engineers

Kansas City, Missouri

According to the July-August issue of Mid-West Municipal Utilities Publication, the City Water and Light Plant of Columbia, Missouri, in 1945 contributed to the total general revenue of the City of Columbia the sum of $92,106.35, plus an additional $10,000.00 special appropriation to the City Street Maintenance fund; and, in addition, "loaned" $27,500.00 to the Municipal Airport fund.

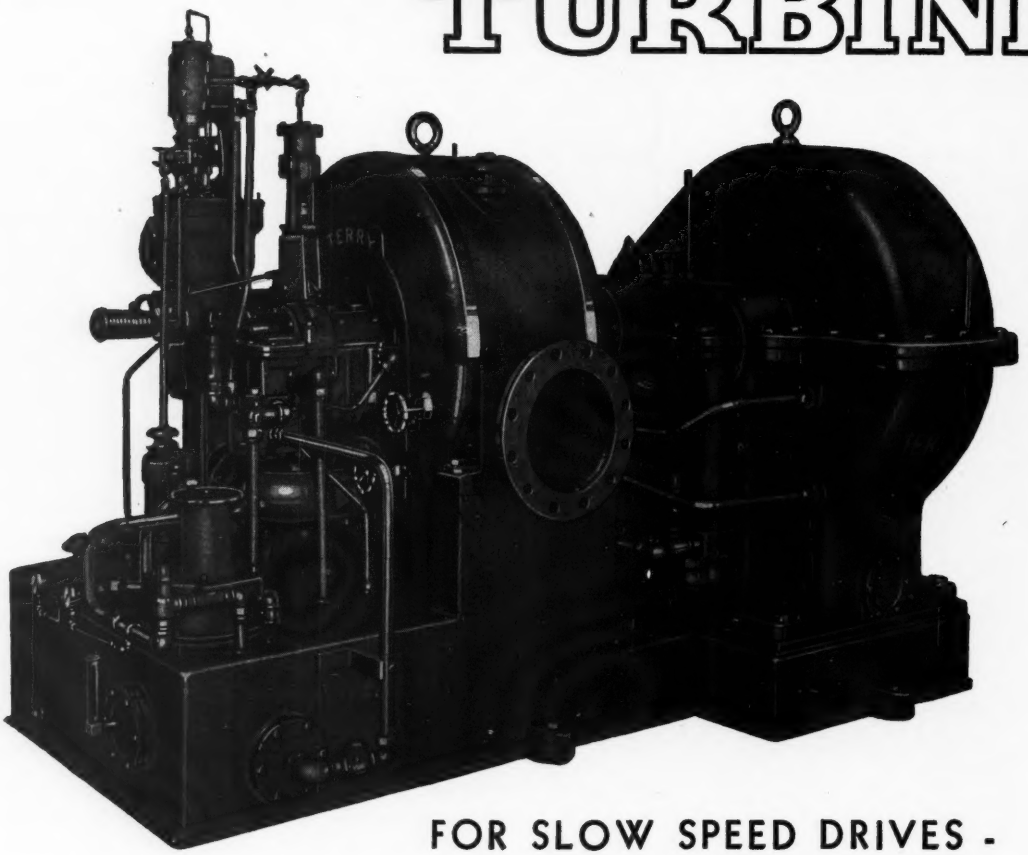
The total general revenue from all sources of the City of Columbia, Missouri, for 1945 was $212,279.67.

After making the above contributions for general revenue purposes, the Water and Light Plant purchased another $50,000 in Government bonds, and has a total of $584,650.00 in bonds and a cash reserve of $263,083.99 to use on maintenance and expansion program, which ultimately will involve better than $1,000,000.00.

ENGINEERING COMPANY

OFFICES: Marquette Building, Detroit, Mich. Bell Building, Chicago, Illinois
154 Nassau Street, New York City Twenty-Two Marietta Bldg., Atlanta, Ga.

The TERRY TURBINE



FOR SLOW SPEED DRIVES -
ACCURATELY DESIGNED TERRY TURBO-GEAR UNITS

For driving slow speed fans, D. C. generators, paper machines, large pumps, and the like, Terry Turbo-Gear Units offer many advantages.

—The Turbine can be — A Solid Wheel Type — A Single Stage Impulse — or a Multi-Stage Impulse Design, whichever fits your requirements best.

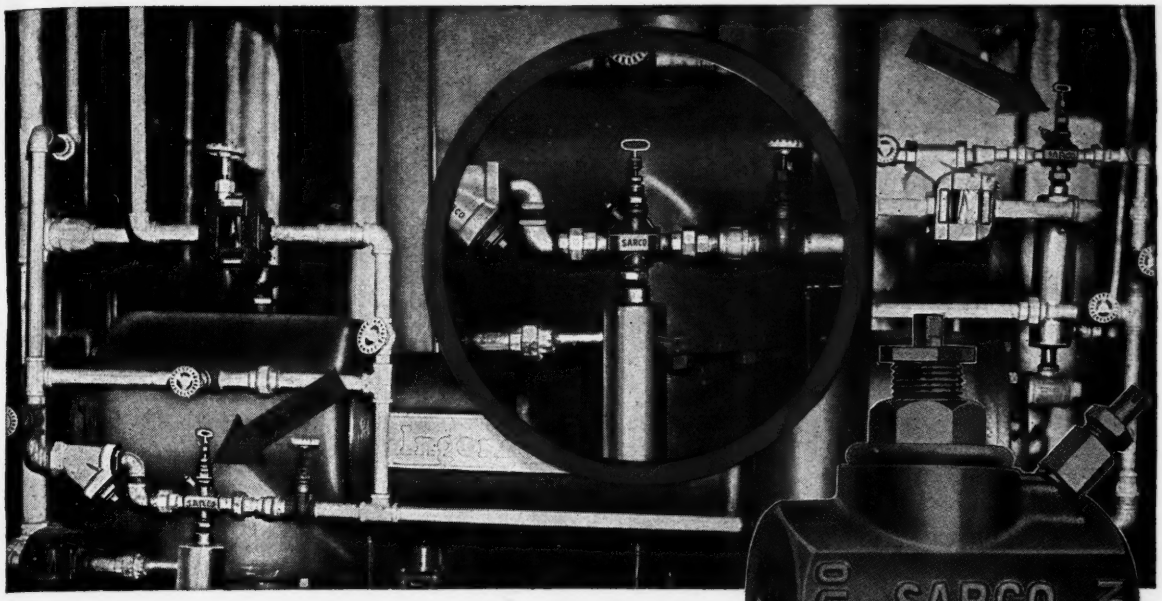
—The Gear is not just an ordinary gear but is a carefully designed and constructed power transmission unit built entirely for the high speeds encountered in turbine practice. Each gear is engineered for the job conditions. Forced feed lubrication is used on the bearings and the meshing teeth. The teeth are double helical and are generated on precision gear cutting machines. The bearings are of the Babbitt lined sleeve type and are unusually heavy so as to prevent distortion under load. All rotating parts are carefully balanced.

A typical Terry Turbo-Gear set is shown above. This unit delivers 300 H.P. with steam conditions of 250 lbs. 150° and 20 lbs. back pressure. The turbine is of the axial flow single stage type and operates at 4230 R.P.M. The gear reduces this speed to 470 R.P.M. The governor is of the oil relay variable speed type and is equipped with remote speed control.

If you have a specific turbine drive job, a Terry engineer will be glad to discuss it with you. — Descriptive bulletins on request.

T-1164

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.



LESS WATER-LESS OIL-CLEAN AIR

and Greater Compressor Efficiency

TR 40 COOLING CONTROL

Sarco TR-40 Cooling Controls, applied to your air compressor, will save four ways, and it's a question which of these will prove most valuable to you.

Water consumption will be cut 25 to 50%. By preventing under-cooling, lubricating oil will be saved.

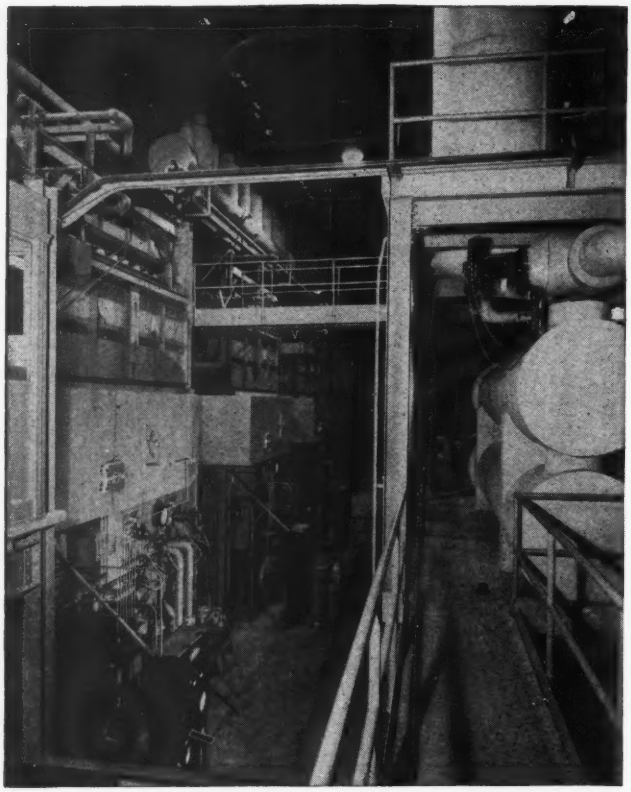
No burned oil can get into your air lines because overheating is definitely prevented. Correct jacket water temperature, automatically maintained, will increase compressor efficiency.

The TR-40 Cooling Control installed on the 3-story-high condenser shown at the right saved three-fourths of the water, increased the output and insured uniformity. It is used extensively on degreasers and food equipment and is frequently found as part of the original equipment. The cost is small—quickly recovered. Ask for Catalog No. 700.

139

SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
475 FIFTH AVE., NEW YORK 17, N. Y.
SARCO CANADA, LTD., TORONTO 1, ONTARIO

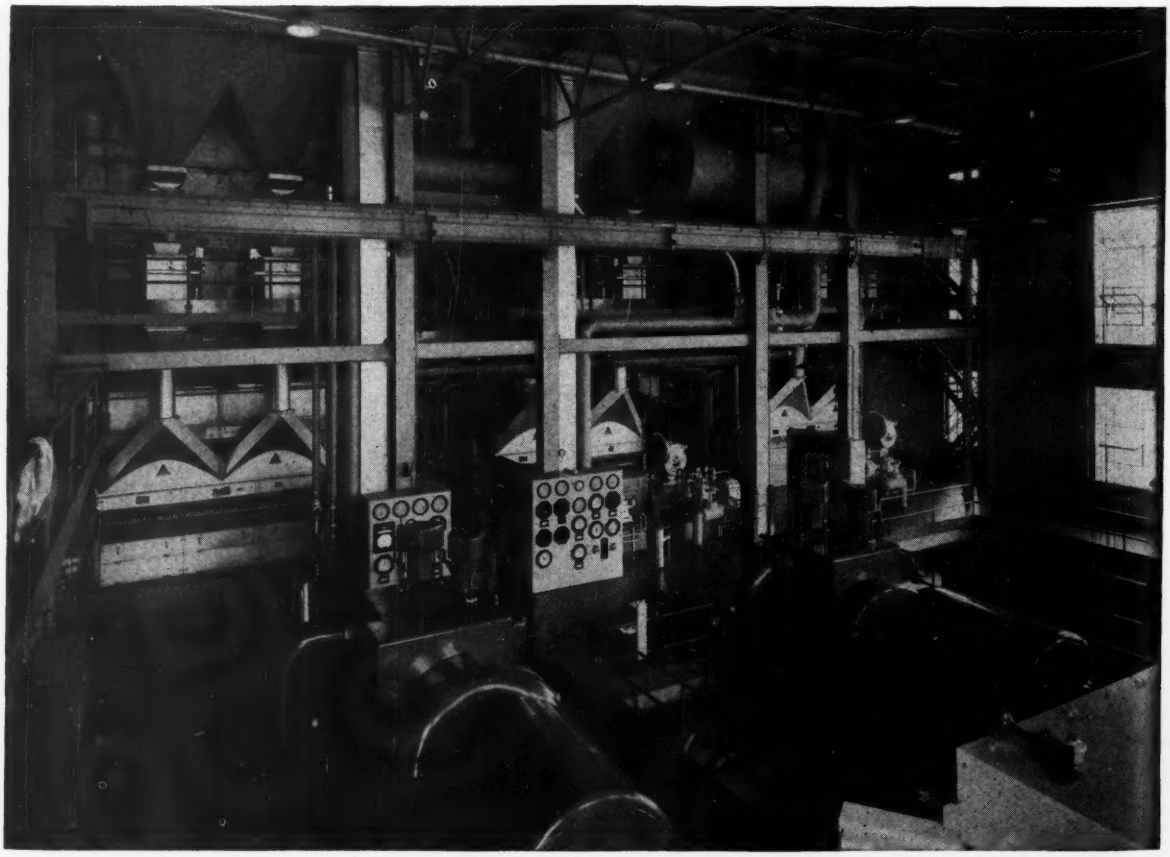


IT TAKES

Left:
Interior view of a new 400,000 lb. steam generating plant suppling steam for a modern industrial plant. Steam is generated in three gas fired boilers which are operated by a Republic automatic combustion control system.

See Our Exhibit, Booth 6, 17th National Power Show

Below:
A Republic combustion control system operates the three boilers in this new power plant which supplies all the steam and power for a large university. During the first year of operation this new plant provided heat for 13.0 percent more building space, generated 114.3 percent more electric power but consumed 9.86 percent less fuel.



MORE THAN A GOOD BOILER TO CUT STEAM COSTS!

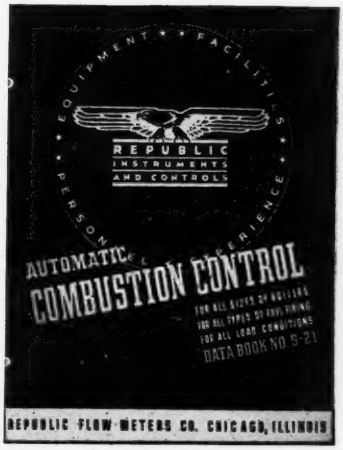
Low Steam Cost Is Not The Result Of Efficient Boiler Design Alone! It Is Determined By The Degree With Which Your Method Of Boiler Control Takes Full Advantage Of Those Economies Which Have Been "Built In" The Boiler And Its Auxiliaries.

To realize all the financial and operating advantages of modern boilers, they must be closely controlled. They have comparatively small water storage spaces and high combustion rates, hence under some conditions may be very sensitive to load fluctuations. In operating them, therefore, a number of repetitive adjustments must be made frequently and practically simultaneously on several units of auxiliary equipment in order to maintain highest boiler efficiency. The difficulty of making the required repetitive adjustments accurately and synchronously by hand at the individual auxiliaries is obvious.

What is needed, therefore, is a method for making and co-ordinating these adjustments automatically from a centralized control point, at the same time permitting the operator to assume manual control at this point whenever necessary or desirable.

The REPUBLIC combustion control is a unified system controlling simultaneously, in measured quantities and in fixed (adjustable) proportions, the fuel and air input to the boiler. It increases or decreases the fuel and air supply to the boiler in the correct amount to maintain constant steam pressure and in the correct ratio to maintain maximum combustion efficiency.

REPUBLIC combustion control systems are designed and built for all sizes of boilers—all types of fuel firing equipment—all load conditions. They fulfill all the conditions of theoretically perfect combustion control and still meet all the demands of every-day operating requirements.



This 94 page data book on automatic combustion control is filled with usable information generally difficult to locate. If you are interested in the advantages of automatic combustion control, write for Data Book No. S-21.

REPUBLIC FLOW METERS CO.

2224 DIVERSEY PKWY. CHICAGO 47, ILL.

THE HIGH PRESSURE PACKING WITH THE LOW MAINTENANCE COST

GARLOCK 150

Low in maintenance cost because it gives such *long, dependable* service. Costly shutdowns for frequent repacking are avoided. Man hours and machine hours are saved. Use GARLOCK 150 on piston rods of engines, pumps, compressors, etc., against steam pressures up to 300 lbs.

The Garlock Packing Company, Palmyra, New York

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK 150 *Spiral packing, illustrated. Coil*—GARLOCK 125 *Rings*—GARLOCK 200

Efficient 17 *Years Ago*

BETTER THAN EVER TODAY

Accepted as cost cutting, efficient, fuel-firing equipment 17 years ago, the Perfect Spread Stoker *is still better today.*

Using the principle of operation which marks its 17 years of successful performance, it has been streamlined and improved. It combines many operating features not available in any other stoker—handles all types of coal efficiently, economically.

Fuel and maintenance savings are assured with its dependable operation. Its easy-to-clean, pleasing exterior adds modern appearance to your boiler room. Before buying fuel firing equipment investigate the Perfect Spread Stoker. Write for descriptive booklet *today!*

Feed this stoker the lowest available grade of coal! Watch it operate perfectly—without clogging—on *any* grade—wet, dry, or partially frozen. This "non-clog" feature is exclusive with Perfect Spread.

Æ

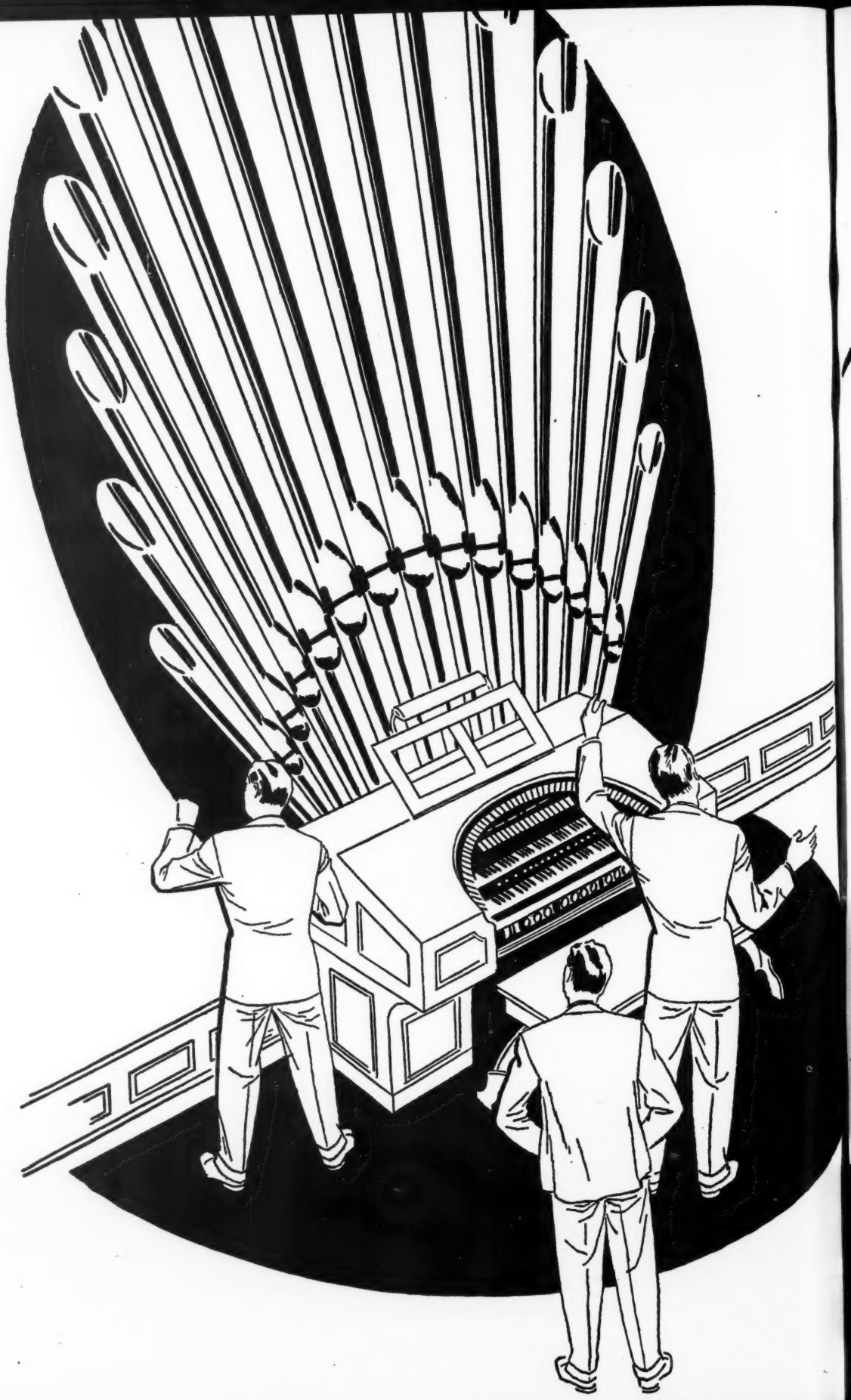
PERFECT SPREAD STOKER

—with stationary grates, dumping grates or continuous ash discharge—up to 400,000 lbs. of steam per hour.

OTHER Æ PRODUCTS: Æ TAYLOR STOKERS, LO-HED HOISTS, MARINE DECK AUXILIARIES, HELE-SHAW FLUID POWER

AMERICAN ENGINEERING COMPANY

2408 ARAMINGO AVE., PHILADELPHIA 25, PENNSYLVANIA



Pipe organ blues

for the plant engineer

The heating plant serving a group of buildings in a Pennsylvania city, was one of the most unlikely places to expect serious trouble. Yet trouble *did* occur several months after boiler water conditioning was started. More and more phosphate had to be used, and still the tests showed that the concentration in the boiler water was much too low.

A check-up indicated that the makeup water was satisfactorily low in hardness when it left the softener, so the only possible conclusion was that somehow there was raw water contamination of the condensate. The plant engineer didn't see how this could possibly happen, and there was certainly no such contamination at any point in the main building. Attention therefore turned to the other buildings.

The inspection started at the least likely spot—an auditorium. Nothing there, the plant engineer explained, but bare walls. Steam was used for heating only. When the Hall engineer admired the great pipe organ, his guide began to tell him about it—the musicians who had praised it, statistics about the number and size of the pipes and so on. An instrument of this size, he pointed out, had to be carefully treated. Humidity had to be just right, or the tones would not be true. In fact a special air conditioning system had been installed inside the organ, and was always turned on a short time before each concert.

That was all the cue the Hall engineer needed, and the plant engineer, too, got the idea his own words had suggested. Together they inspected the air conditioning system. They found first of all that it hadn't been turned off after the last concert held some two weeks before. Then they traced the piping—and found that the overflow which was, of course, untreated was discharging into the condensate return line, and thereby getting back to the boilers.

Tracing boiler water trouble to a pipe organ is unique—however, it is not unusual to find the source of trouble in work done by someone who failed to understand the connection between that work and the steam generating system. Our records show that time and again the troubles encountered in plants that have Hall service are due to factors other than water.

The ability of Hall engineers to trace and correct these troubles is one reason why *every plant that generates its own steam can profitably use Hall service.* We will be glad to send you full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.

(A Subsidiary of Hagan Corporation)

HAGAN
HALL
BUROMIN
CALGON

HALL SYSTEM *of Boiler Water Conditioning*

CASTINGS . . . *but they were "machined" in the mold!*

Now—all the advantages of Monel, Nickel and Inconel—available in PRECISION CASTINGS

HERE'S another way to lick tough design problems . . . *precision castings of Monel, Nickel and Inconel.*

The new INCO Precision Castings Plant is now in operation . . . built and equipped after years of pilot plant study, after thousands of experimental castings.

Check what this development means:

1 **Precision Castings of Precision Accuracy** — INCO precision castings are commonly made to tolerances of ± 0.003", and frequently to even finer tolerances.

2 **A Saving in Time and Money** — In general, INCO precision castings eliminate machining or other fabricating operations normally involved in making parts. This is particularly noteworthy where the design calls for intricate features and contours. Grinding away of the sprue and sand blasting are usually all that's required to make an INCO precision casting ready for assembly into the finished product.

3 **Broader Use for the INCO Nickel Alloys** — The flexibility of design permits the INCO Nickel Alloys to be used in shapes which frequently were neither economical nor practical to obtain as sand castings or by machining from forged stock or deep forgings.

4 **Dependable Source of Supply** — INCO handles precision castings as a mass production process . . . you can count on quick, steady production from INCO.

•

Perhaps an INCO Nickel Alloy precision casting is your answer to the need for faster production...for hardness, greater protection against stress, corrosion, high temperatures, wear and fatigue.

Let's go over your job together. Just send us a blueprint (or an actual sample). We'll be glad to work out all the information you want.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall Street, New York 5, N. Y.

NICKEL (INCO TRADE MARK) ALLOYS

MONEL* • "K" MONEL* • "H" MONEL* • "R" MONEL* • "S" MONEL* • INCONEL* • NICKEL • "L" NICKEL* • "Z" NICKEL *

*Reg. U. S. Pat. Off.

INCO PRECISION CASTINGS SAVE TIME AND MONEY

FUEL PUMP ROTOR

Formerly required 3 or 4 operations on 3 to 5 different machines. Note grooves on internal surface.

CLUTCH GEAR

Saved complicated machining. Also avoided at least one sub-assembly, i.e., force-fitting, welding or brazing the projecting key on small end.

FLIGHT CONTROL INSTRUMENT COVER

(*Cutaway section*) Originally machined from bar stock, taking a 9-day production schedule. Note intricate recesses and studs in recesses.

Above parts are made of "S" Monel

A FOSTER WHEELER FIRST

EXPANDED TUBE CONDENSERS *for purest feed water*

Expanded tube condenser design, introduced 20 years ago by Foster Wheeler and considered a highlight of condenser development, is used by modern condenser manufacturers. The design completely eliminates leakage of circulating water into the condensate.

Condensate contamination became a major problem with the advent of higher pressure and temperature steam generators. Slight impurity of feed water, unnoticed for years in plants operating at 300 or 400 psi, quickly forms heavy scale at higher pressures and temperatures. Modern steam generators need almost chemically pure feed water — purer than drinking water.

Foster Wheeler anticipated this problem by designing the first expanded tube condenser for stationary power plants.

The condensers illustrated, first practical application of this design, were built in 1925 by Foster Wheeler for the Trinidad, Texas, station of the Texas Power & Light Company. Test data proved that expanded tube condensers provide feed water purer than all previous types.

Foster Wheeler offers industry practical engineering ability and experience plus foresight necessary for progress.

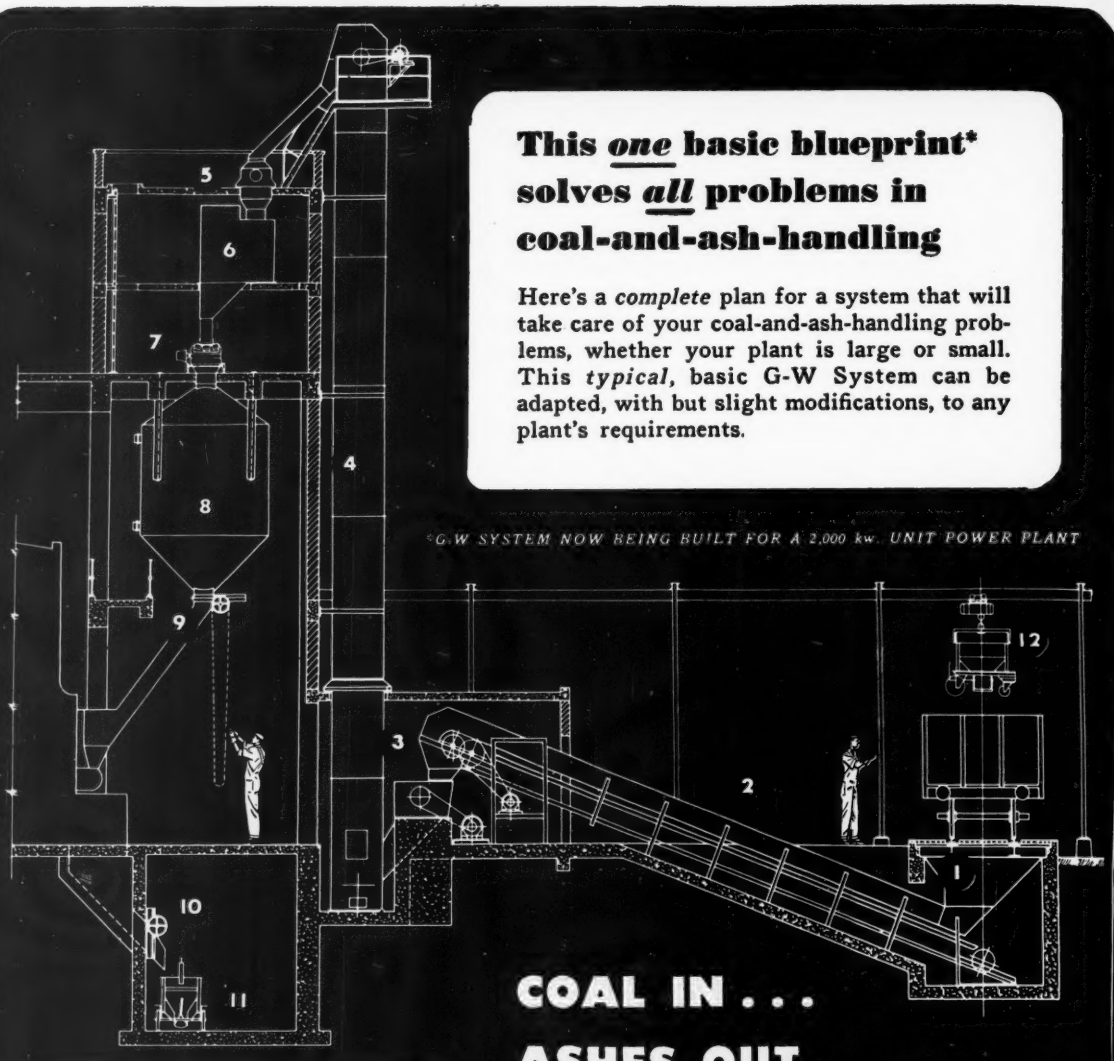
Foster Wheeler Corporation • 165 Broadway, N.Y.6, N.Y.

FOSTER WHEELER

This *one* basic blueprint* solves *all* problems in coal-and-ash-handling

Here's a *complete* plan for a system that will take care of your coal-and-ash-handling problems, whether your plant is large or small. This *typical*, basic G-W System can be adapted, with but slight modifications, to any plant's requirements.

*G-W SYSTEM NOW BEING BUILT FOR A 2,000 kw. UNIT POWER PLANT



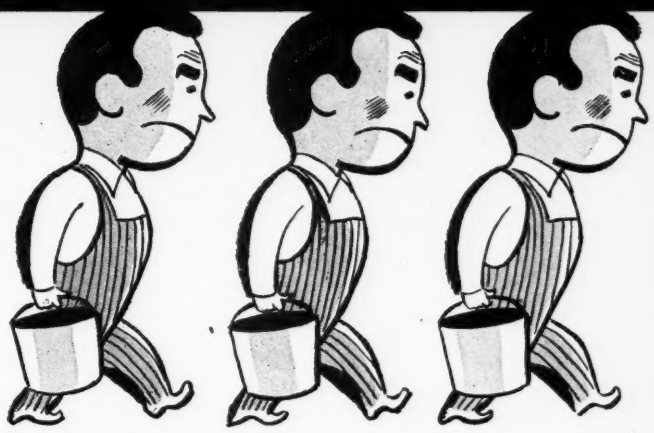
COAL IN . . .
ASHES OUT

1. Coal passes through *Grating, Hopper* and *Control Gate* to feeder pans.
2. *Apron Feeder* draws coal from hopper, conveys it at uniform rate to crusher.
3. *Crusher* delivers stoker-sized coal to elevator boot.
4. *Bucket Elevator* discharges coal to surge hopper.
5. *Surge Hopper Control Unit* assures constant supply to scale.
6. *Scale* automatically weighs, records and discharges to shuttle belt conveyor.
7. *Shuttle Belt Conveyor* serves several bins from central weighing point.
8. *Storage Bins* have coal level control.
9. *Control Gate* and *Spout* to stoker.
10. *Ash Unloading Gate.*
11. *Ash Cart* manually operated through tunnel.
12. *Ash Cart* electrically operated for ash disposal.

G-W HANDLES IT . . .
faster • easier • cheaper

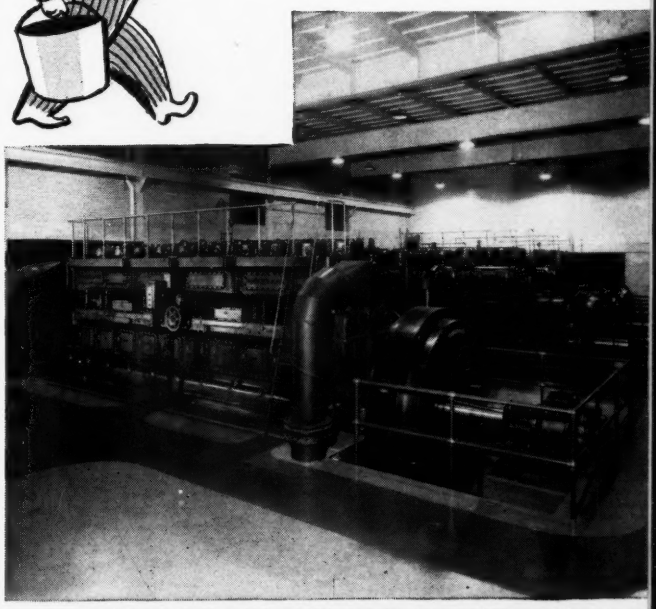
SINCE 1814

From 3 buckets of port carbon a week to just one



BEFORE this Illinois Municipal power plant operated on Nonpareil HD Diesel Oil, the three Diesels—one 850 H.P. and two 1,050 H.P. engines—were cleaned of port carbon weekly. Three 12-quart buckets of carbon were removed at each cleaning. When the 2,000 H.P. engine in the foreground was installed Nonpareil HD Diesel Oil was used. One of the immediately noticeable results was the comparative freedom from port carbon deposits on this new Diesel. Within a year the three older engines were put on Nonpareil HD. Then there was no doubt. Port carbon dropped to one-third—less than one bucket of carbon a week for all three engines.

Minimizing of port carbon is just one of Nonpareil HD's maintenance saving advantages which operators *have proved for themselves* in hundreds of similar installations. What is your Diesel lubricating problem? There's a Standard Oil Lubrication Engineer ready to help you solve it if your plant is located in the Midwest. Just write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for the Engineer nearest you.

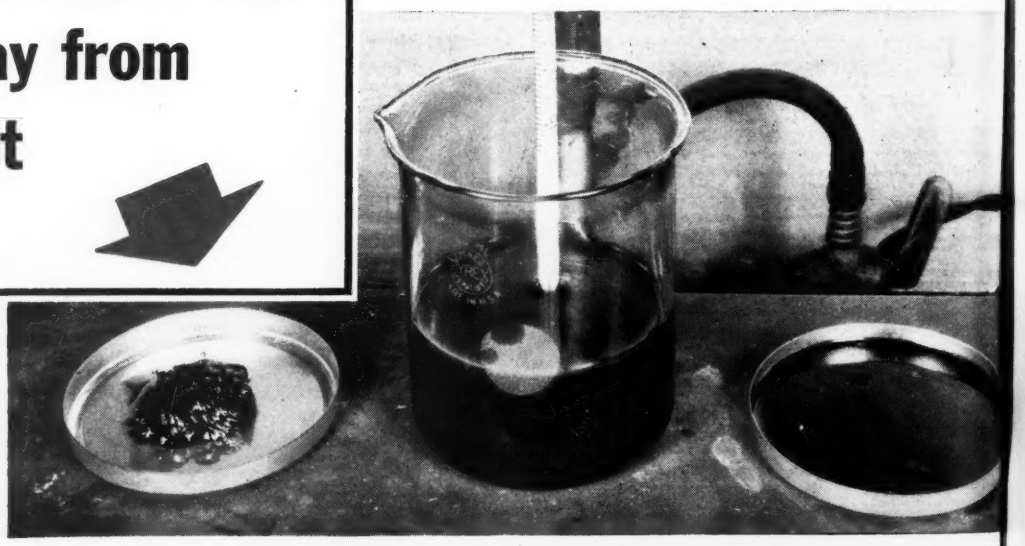


NONPAREIL HD DIESEL OIL

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

A gear lubricant that won't run away from heat

(Above) Two samples of grease, Calumet Viscous Lubricant on left and a residuum type gear shield, right. These samples are placed on a hot plate (below) and heated to 320°F. as determined by the thermometer in the beaker of oil. Within 60 seconds the old type gear shield has melted and spread over the pan. There is little or no change in structure of Calumet Viscous Lubricant even at this high temperature.



THE SIMPLE TEST described here shows why Calumet Viscous Lubricants reduce throwoff, cut lubricant consumption and protect open gears for long periods of time even though subjected to elevated temperatures.

Calumet Viscous Lubricants have these qualities because they are not the old type gear shields but are true greases made from selected soaps and oils of proper viscosities. They do not require heating before application, and all but the heaviest grades can be sprayed. Both features offer a further saving in time and grease.

A Standard Oil Lubrication Engineer will help you select the grade you need for low cost open gear lubrication.

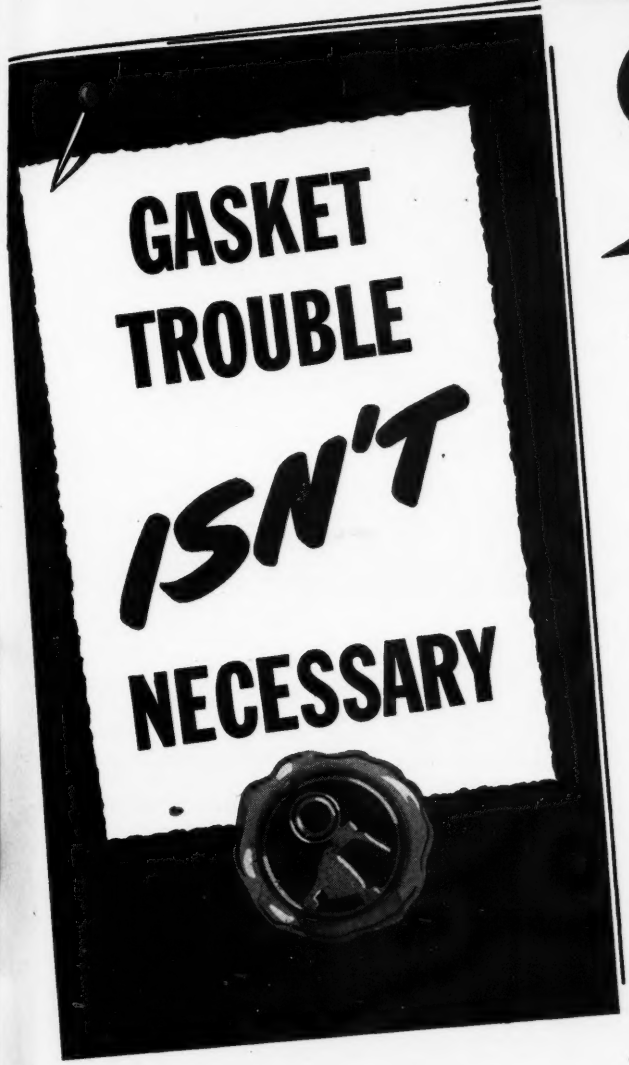
Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

CALUMET Viscous Lubricants

STANDARD OIL COMPANY (INDIANA)

STANDARD SERVICE

You Ought to Get?



If you take gasket troubles for granted, here's a fact that you should know —

Most of those troubles are unnecessary.

Why? Because you're using a gasket that's *almost* right for its particular application. By getting the gasket that's *exactly* right, you get maximum durability, and *100%* joint efficiency.

To eliminate these unnecessary troubles, let the experience of the Goetze research laboratories help you survey your gasket applications. They can recommend the gasket that exactly suits your particular conditions of temperature, pressure or corrosion, and you can probably get the gasket from the regular Goetze line—the only complete line of metal gaskets. If you need something special, Goetze engineers may be able to develop a special gasket for you.

We invite your inquiries—what are your problems? Give us the details on your company letterhead, or get in touch with the nearest Goetze representative.

GOETZE GASKET & PACKING CO., INC.

17 ALLEN AVENUE, NEW BRUNSWICK, NEW JERSEY

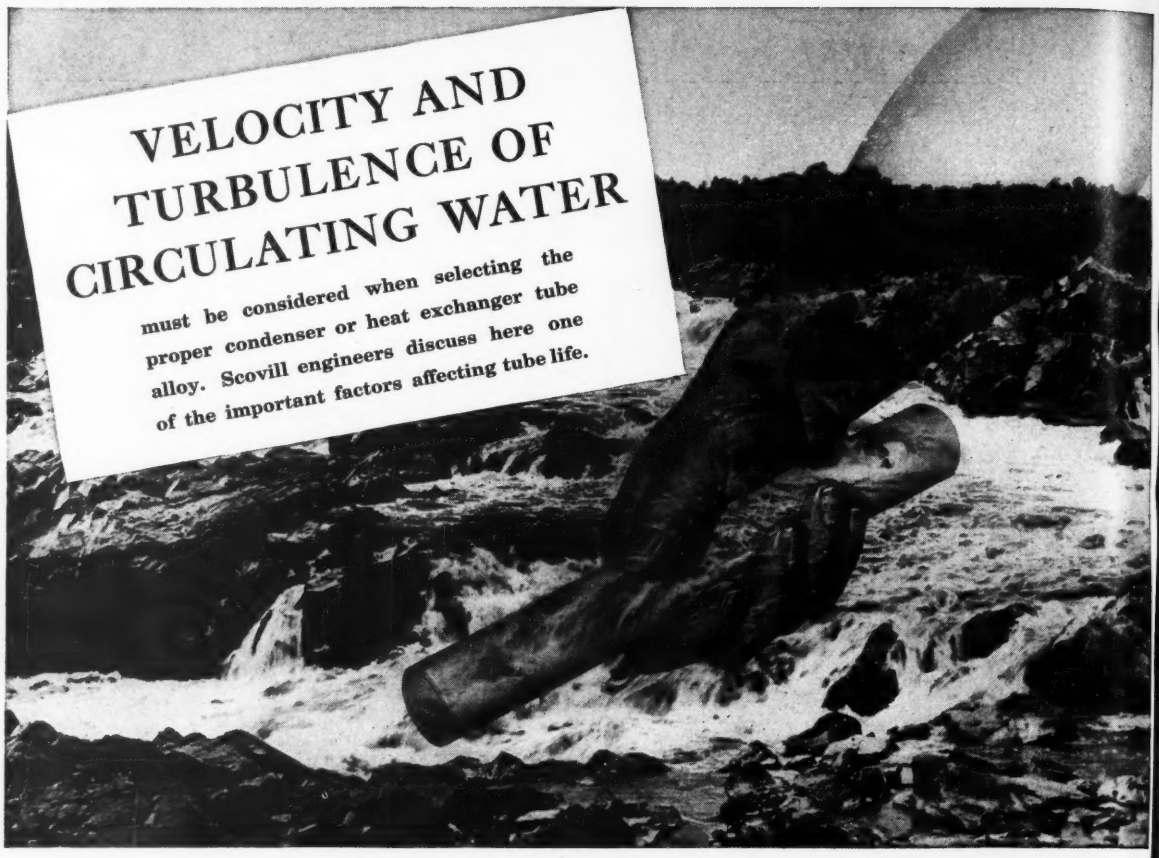
Boston	Cleveland	Detroit	Chicago
Cincinnati	San Francisco	Los Angeles	Buffalo
Houston	Philadelphia	Pittsburgh	Denver
New York	New Orleans	St. Louis	Montreal
	Toronto	Syracuse	

Lowell Thomas Speaks On New Gasket Film

Now available to employee groups, technical societies, engineering schools and other organizations throughout the country, this new 35-minute Kodachrome film, "Only a Gasket," tells why these are the "Biggest little things" in modern industry. Write for full information.

Goetze for GASKETS

"America's Oldest and Largest Industrial Gasket Manufacturer"



VELOCITY AND TURBULENCE OF CIRCULATING WATER

must be considered when selecting the proper condenser or heat exchanger tube alloy. Scovill engineers discuss here one of the important factors affecting tube life.

High velocity and turbulence of the circulating water, especially if entrained air or abrasive material is present, tend to promote tube attack of the erosion-corrosion type. In this type of attack the original corrosion product, which otherwise might act as a protective film, is worn away as fast as it is formed, exposing bare metal for further corrosion.

In actual operating conditions, where velocity and turbulence of the circulating water constitute only two of the variables, tube life depends on the nature and/or extent of such other factors as:

Abrasives suspended in the coolant . . . Dissolved or entrained air or gases . . . Temperatures inside and outside of tubes . . . Chemical or electro-chemical actions . . . Marine growths or other deposits . . . Sewage and wastes present . . . Development of protective film . . . Media surrounding tubes.

One of the principal objects of Condenser Tube Technical Research has been the development of alloys designed to give the user longest tube life and most trouble-free service. Among the alloys developed to give a high degree of resistance to erosion-corrosion attack are Aluminum Brass and 70-30 Cupro–Nickel, each within its pertinent temperature limitations.

So many variables surround any condenser or heat exchanger tube application that each case must be treated as an individual problem.

Data accumulated during Scovill's continuous study of condenser and heat exchanger tube service conditions for every known application equip its Technical Service Department to offer sound guidance in tube alloy selection for existing or proposed installations.

THREE SCOVILL SERVICES

Scovill's *Service in Men* offers experienced engineering to help solve your tube selection and installation problems. *Service in Metals* develops and produces Scovill tube alloys that conform to your requirements. *Service in Manuals* consists of literature which gives you latest, authentic information on condenser and heat exchanger tubes. For a free copy of Condenser Tube Booklet, address Scovill Manufacturing Co., 17 Mill St., Waterbury 91, Conn. *Export Dept.* 405 Lexington Ave., New York 17, N. Y.

SCOVILL

SCOVILL

CONDENSER TUBES

One Product • Three Services

Service in Manuals . Service in Metals . Service in Men

STEAM PLANTS

FROM BAILEY CONTROLS

1. Get More Steam Per Dollar

Save on fuel
Save on maintenance
Save on power for auxiliaries

2. Deliver Better Power Service

Reduce forced outages
Increase unit capacity
Maintain steam pressure on load swings
Insure adequate process steam
Prevent steam waste

3. Insure Safer Operation

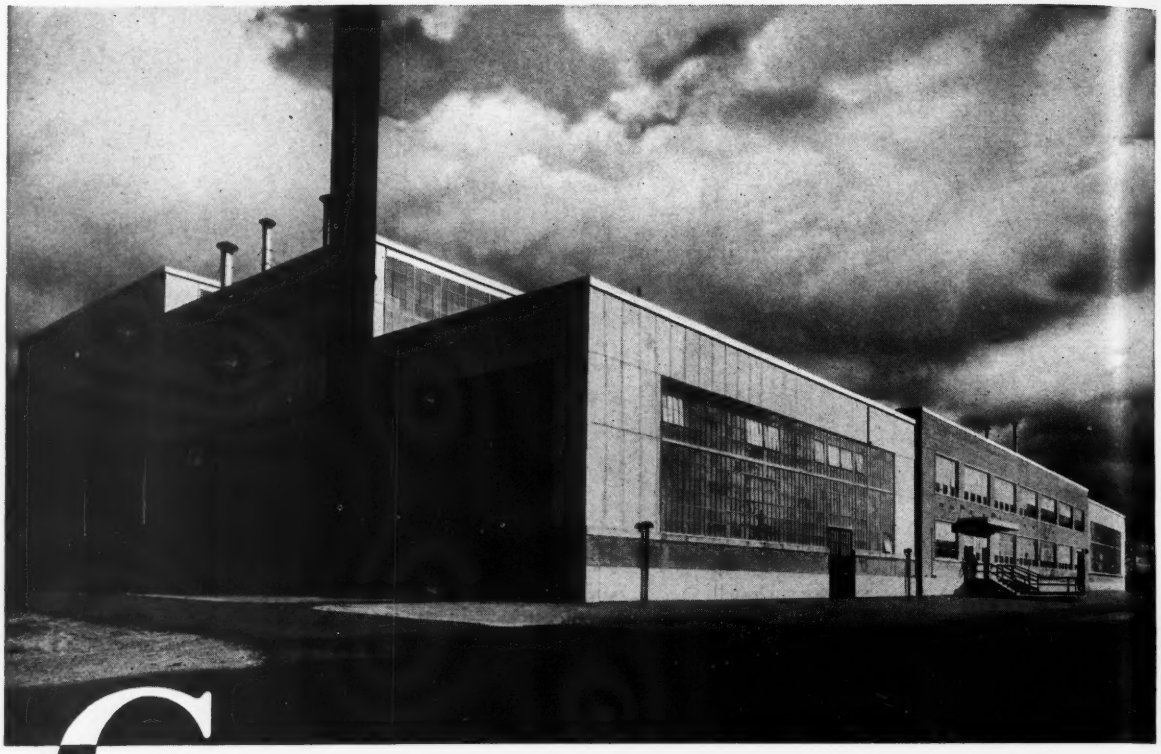
Reduce explosion hazard
Free operators to check any sign of trouble
Prevent excessive steam temperatures
Prevent water carryover and low water
Protect feed pumps at low rates

Application to Your Plant

If you would like to have this 3-way profit of money saving, improved power service, and greater safety for your plant, call on your local Bailey Engineer. He will analyze your layout and make recommendations. He is in a position to help you secure the 3-way profit which results from the intelligent use of correctly selected and properly coordinated steam plant controls.

BAILEY METER COMPANY
1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO
Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

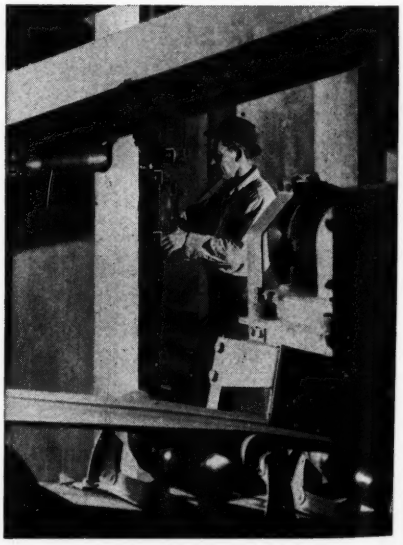


GIVING DUST THE BRUSH-OFF

Result: . . . better working conditions

Heat and dust from top charging furnaces are drawn off at source, instead of being disseminated throughout the steel foundry of the Chapman Valve Manufacturing Company at Indian Orchard, Massachusetts.

The complete plant . . . offices, health clinic, laboratory and production facilities . . . was designed and built by Stone & Webster Engineering Corporation in 11 months from date of authorization.



STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

When It's Saturday Night
FOR YOUR BOILER

Boiler-cleaning time in your plant may roll around often, or not, depending on your particular operating conditions, but it's a safe prediction that sooner or later your boilers are coming out of service for off-the-line attention.

How soon, and how much cleaning will be required, is something you can't determine on the basis of past performance, for it's what goes on *today*, on the water side of tubes and drums, that decides the cost in time and dollars.

APEXIOR NUMBER 1, brush-applied to new or newly cleaned boiler interiors, holds that unseen activity within safe bounds by preventing water-metal contact. Because it fills and seals the porous surface structure of bare steel, this protective coating not only gives complete protection against water-activated deterioration, but so smooths the metal that operating deposits cannot gain a foothold. Those that may gather are easily removed by mechanical or chemical cleaning, as only a light bond is formed with the APEXIOR surface. That's why, when you APEXIORize your boilers, you can count on

- *cleaner operating surfaces, for better heat transfer*
- *longer runs, with improved on-the-line service*
- *less outage time for cleaning and inspection*
- *lower maintenance costs*
- *sustained high operating efficiency, for all steam- and boiler-water-exposed surfaces.*

APEXIOR NUMBER 1 is recommended by every boiler insurance company in the United States and Canada — is standard metal surfacing for power and process equipment — is specified by Federal, State and Municipal governments — and is in use in thousands of public utility, industrial, marine and locomotive boilers.

For metal in "cold-wet" service, a companion coating, APEXIOR NUMBER 3, provides similar lasting protection. Recommended for surfaces exposed to fresh or salt water at temperatures to 125°F.

Our Industrial Bulletin tells the APEXIOR story. Write for your copy to THE DAMPNEY COMPANY of AMERICA, 1112 River St., Hyde Park, Boston 36, Mass.

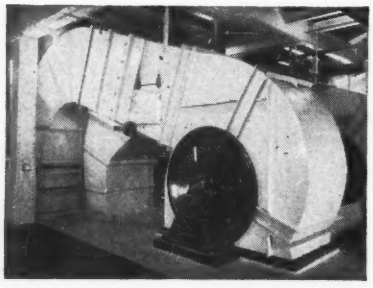
THE DAMPNEY COMPANY OF AMERICA

APEXIOR

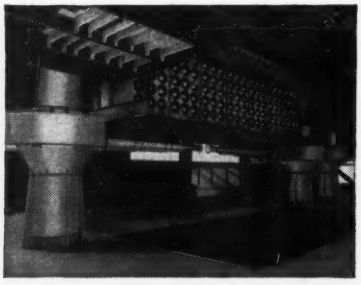
MANUFACTURERS ALSO OF THUR-MA-LOX HIGH HEAT RESISTANT COATINGS — EFFECTIVE TO 1600°F.

You, too, can crack the whip on THREE AT A TIME!

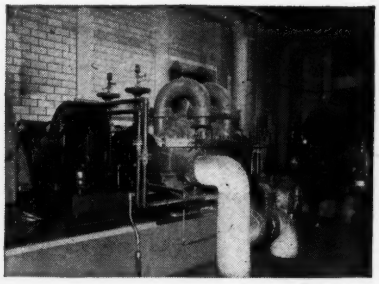
One source for technical information—undivided responsibility —less red tape when you buy all three from ABC! That's the way you can crack the whip on your problems on Mechanical Draft Fans, Fly Ash Precipitators, Variable Speed Control.



1 Mechanical Draft Fans of high operating efficiency and long life are standard with American Blower. Since 1881 we have built fans for many of the leading public utilities and a wide range of industrial applications.



2 Fly Ash Precipitators of simple, but effective design have resulted from our long association with power plants and power plant equipment. American Blower Precipitators have no moving parts, occupy minimum space.



3 Gyrol Fluid Drive was pioneered and introduced to industry by American Blower. Here is the answer to stepless variable speed control for both mechanical draft and boiler feed pump drive — a big help to overall power plant efficiency, too!

At your request, the nearest American Blower Branch Office will make a complete presentation with technical data and prices. Phone or write today.

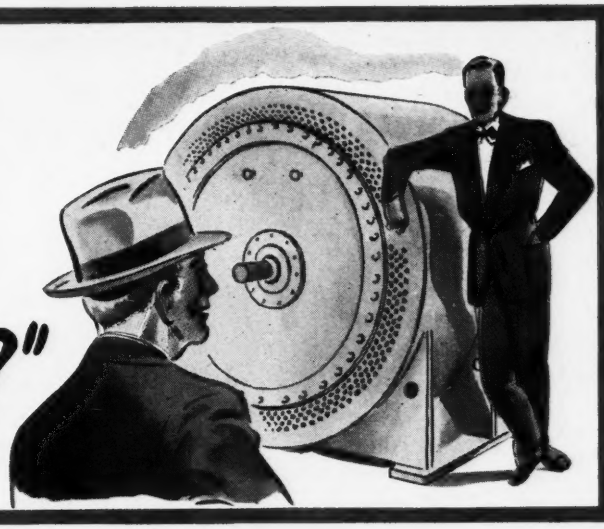
Buy all 3 from ABC

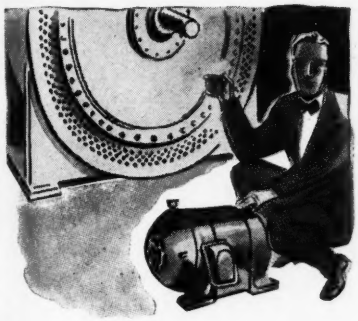
AMERICAN BLOWER

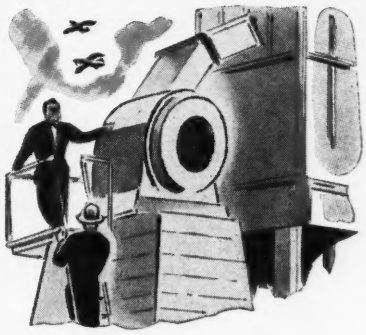
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN

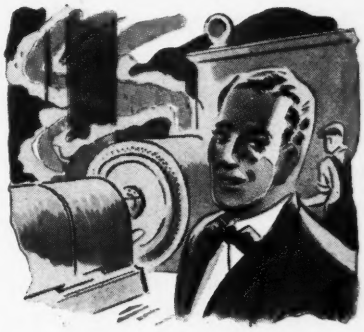
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

"Did You Say, Up to 2000 hp ...Weatherproof?"





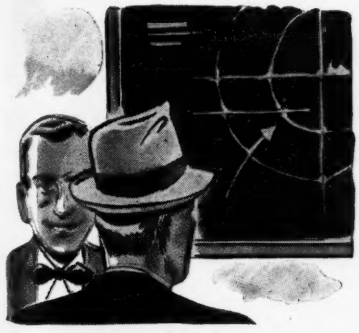




"Right. In Allis-Chalmers' modern motor line we're now prepared to offer you a *complete range* of outdoor weatherproof, totally-enclosed motors all the way from small, standard ratings to sizes of 2,000 hp or larger."

"Why, That Means Then," our customer exclaimed, "in larger ratings they fill the need of power plant engineers who want to install equipment like draft fans *outside,* and thus keep down structure costs per kw capacity." Right again —and they fit into *other* industries too!

Chemical, for instance. Here cast iron motors have generally been preferred ... because they stand up better under acid and alkali conditions. But now these *new* motors, with *new* design improvements, promise to provide several important operating advantages ...



We've Re-designed the heat-transfer system to *improve ventilation.* We've *reduced maintenance* by making air passages not only more accessible, but practically *self*-cleaning as well. And we've *eliminated* liquid and dirt-trapping pockets. In the smaller ratings we of course offer our standard design.

Looking for a Good Motor?

SPECIFY "Allis-Chalmers"! For whether your job calls for a large motor like that above, or a small standard machine, you can be sure of getting two things when you specify "Allis-Chalmers:" 1) Exactly the right type and size motor; 2) consistent with the finest quality workmanship of which we are capable.

For the full story of liberal Allis-Chalmers motor construction, call our nearby dealer or sales office. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2117

ALLIS CHALMERS

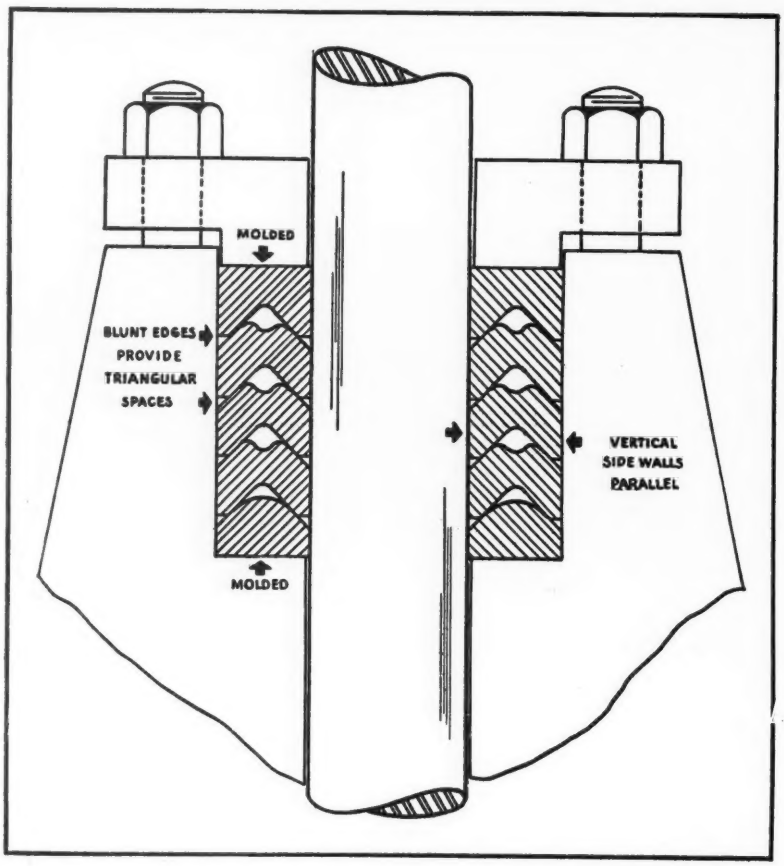
One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

SERVING YOU THROUGH SCIENCE

Exclusive DESIGN!

U. S. MATCHLESS PACKING for rods and plungers

NO OTHER PACKING HAS ALL THESE ADVANTAGES



BLUNT EDGES—Give more efficient shape; allow fabric to reach end of packing, providing uniform strength throughout. In conventional packing (feather-edge design) fabric cannot be forced into sharp edge, leaving unprotected soft-rubber end to cause curling and chipping.

TRIANGULAR SPACES—Blunt edges provide triangular spaces for trapping loose scale, oil, etc. Result is lower coefficient of friction, less power required, and scaling does not score entire length of packing set.

PRESSURE BREAK—The triangular space of each ring breaks the pressure more quickly than ordinary types without this feature. With "Matchless" design, automatic action is faster, more effective.

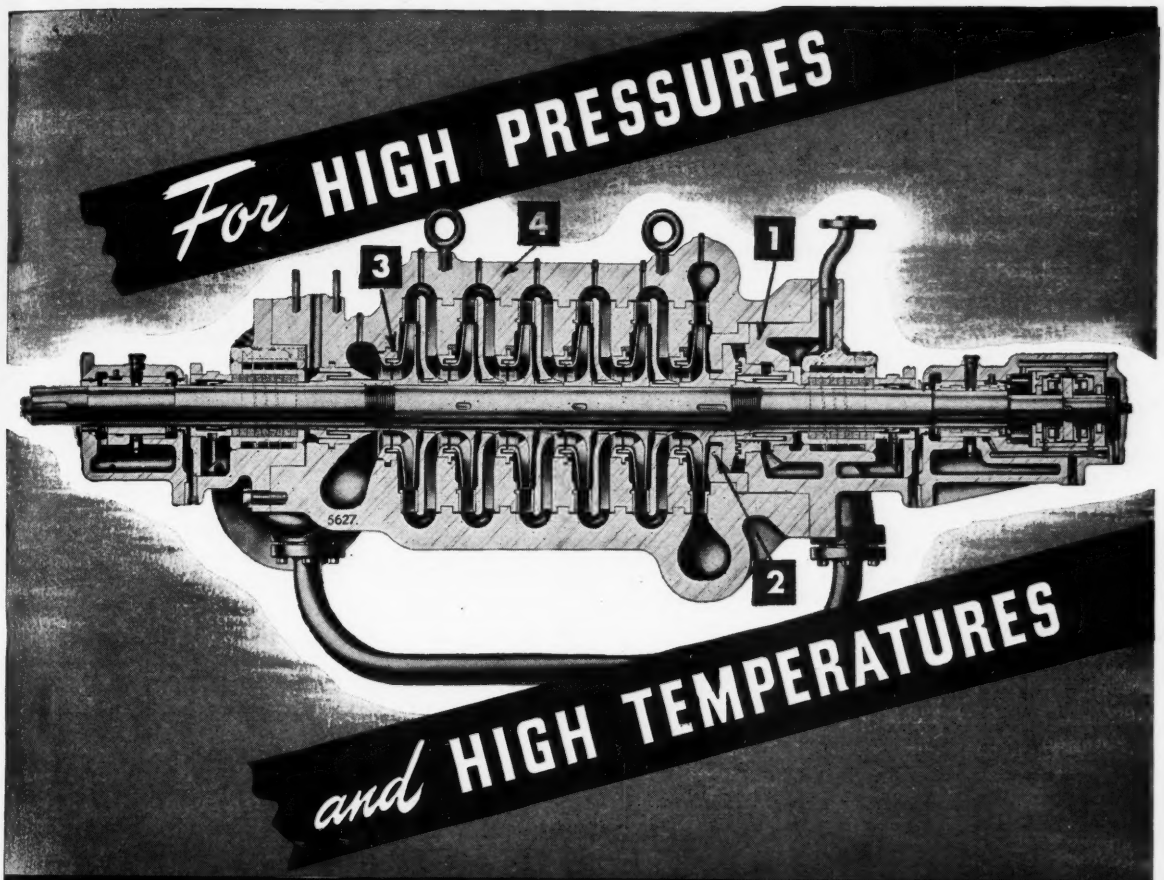
MOLDED END RINGS—Tests show the female ring and the one next to it take 70% of the pressure on the set. In "Matchless" *all* rings are molded, are of proper density, and have no sharp edges to break off, as on end rings cut from slab.

EASY TO INSTALL—Matchless Packing has parallel side walls, while conventional packings are made with varying degrees of wall flare. "Matchless" rings slide easily into stuffing box; the flare type requires considerable effort and time.

For the past twenty-five years "Matchless" has been famous in industry for its unique advantages on hydraulic equipment, presses, rams, triplex pumps, outside packed pumps, and swivels on rotary drilling rigs. The self-adjusting, automatic action of "Matchless" results in reduced wear and tear on rods and plungers, minimizes friction and keeps down packing costs.

UNITED STATES RUBBER COMPANY

1230 AVENUE OF THE AMERICAS • ROCKEFELLER CENTER • NEW YORK 20, N. Y.



DE LAVAL MULTI-STAGE PUMPS

1 **SOLID END-HEAD** prevents leakage around stationary balancing disc.

2 **AUTOMATIC HYDRAULIC BALANCING** leaves no unbalanced thrust to be taken up by thrust bearings or other metallic contacts subject to wear.

3 **LABYRINTH WEARING RINGS** minimize leakage from discharge to suction without requiring close mechanical clearances.

4 **CASINGS AND IMPELLERS** built of materials carefully selected to endure the particular service for which the pump is intended.

When at the Power Show you are cordially invited to visit De Laval Booth No. 43.

MP-1

TURBINES • HELICAL GEARS • WORM GEAR SPEED REDUCERS • CENTRIFUGAL PUMPS • CENTRIFUGAL BLOWERS AND COMPRESSORS • IMO OIL PUMPS

DE LAVAL STEAM TURBINE COMPANY
TRENTON 2, NEW JERSEY

SALES OFFICES: ATLANTA · BOSTON · CHARLOTTE · CHICAGO · CLEVELAND · DENVER · DETROIT · DULUTH · EDMONTON · GREAT FALLS · HAVANA · HELENA · HOUSTON · KANSAS CITY · LOS ANGELES · MONTREAL · NEW ORLEANS · NEW YORK · PHILADELPHIA · PITTSBURGH · ROCHESTER · ST. PAUL · SALT LAKE CITY · SAN FRANCISCO · SEATTLE · TORONTO · TULSA · VANCOUVER · WASHINGTON, D. C. · WINNIPEG

NOW

ALL STAINLESS STEEL (18-8) CONSTRUCTION MAKES TAYLOR *ACCURATUS* THERMAL SYSTEMS

Better than ever!

FRANKLY, we never thought we could improve the quality of Taylor Accuratus Tubing. Its unique in-built construction automatically compensated for temperature variations between the point of measurement and the instrument case. This made it possible to extend the many advantages of mercury actuated systems to applications where long lengths of connecting tubing were necessary.

But now we *have* improved it—with 18-8 stainless steel—giving you these new, extra advantages:

1. **Corrosion resistant.** It will not rust!
2. **Tougher.** Withstands more bending and vibration.
3. **Easily installed.** It's more flexible.
4. **Smaller bulbs.** More adaptable to limited space applications.
5. **Standard** with stainless steel construction from tip of bulb to instrument case.

You get all this *in addition* to these important time-tested advantages of Taylor's mercury actuated tube system:

Uniformly graduated charts **Short ranges**
Great power and dependability **Low initial cost**

As good as it is, we don't recommend the new Taylor Accuratus Thermal System as a cure-all for your temperature measuring problems. We've got a complete department store of thermal systems—mercury, vapor, gas, organic liquid—each with its own definite advantages. No matter what temperature problems you have, Taylor can deliver you the instrument that's best suited to solve them.

Call your Taylor Field Engineer or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, humidity, flow and liquid level.*

Taylor Instruments
MEAN
ACCURACY FIRST
IN HOME AND INDUSTRY

REPORTS OVER 86% EFFICIENCY

DETROIT ROTOGRATE STOKER

First Detroit RotoGrate Stoker Installed in 1942 American Box Board Company, Grand Rapids, Mich.

Repeats

ANOTHER DETROIT ROTOGRATE STOKER

merican Box Board Company, manu-
acturers of container board and con-
iners, has used a RotoGrate Stoker
plied to steam generator since
42. The rated capacity is 110,000
nds of steam per hour. Another
n has been built for an additional Roto-
Grate Stoker for a new 75,000 pound
unit.

Detroit RotoGrate permits high burn-
ing rates with fuels of either high or
low ash content. *Continuous Cleaning—
Forward Moving Grate* Spreader Stoker
—it quickly responds to load changes

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN

District Offices in Principal Cities • Works at Monroe, Michigan

CHANGE THE Speed TO SUIT THE Job..

Texrope Vari-Pitch sheave makes it possible to vary the speed of this ventilating blower up to 25% to meet seasonal changes. Speed adjustment is quickly and easily made. A2102

Economical...TEXROPE Variable Speed Drives!

Whenever variations in speed will add to efficiency, production or economy — use TEXROPE Variable speed drives with standard constant speed motors. A Vari-Pitch sheave may provide all the speed range needed. They're available for stationary or motion control. Wide-Range Vari-Pitch sheaves and V-Belts provide greater range up to 116% — Speed Changers up to 375%.

A Complete Line . . .

Sheaves, Speed Changers . . . V-Belts . . . Engineering Aid. Your nearest Allis-Chalmers office or dealer is headquarters for EVERY type of V-Belt Drive equipment. Save time by buying all your needs from one reliable source. Every item of equipment is designed and backed by Allis-Chalmers — originators of industry's Multiple V-Belt Drive. ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN.

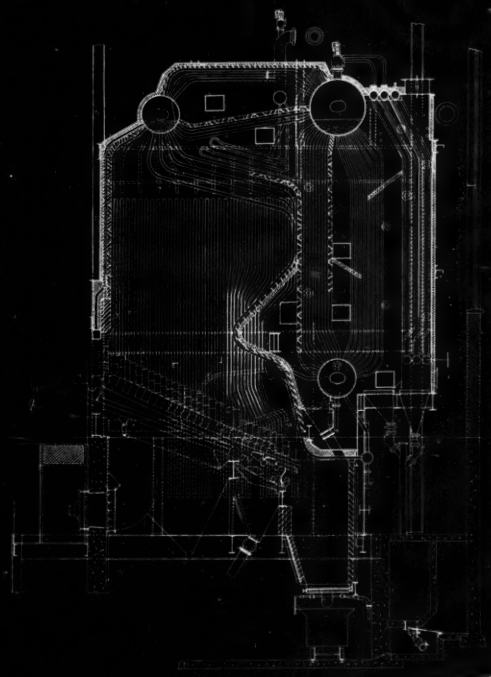
"Magic-Grip" Sheaves are Faster ON . . . Faster OFF

Here's the sheave that requires no filing, reaming or hammering to mount — no wheel-puller or bulging muscles to demount. *It comes completely assembled.* Just slide it on the shaft and tighten three cap screws. That's all! Grips like a vise — no shear, wobble or backlash. No damage to shaft or motor bearings.

ALLIS AC CHALMERS

One of the Big 3 in Electric Power Equipment — Biggest of All in Range of Industrial Products

TEXROPE V-BELT DRIVES



POWER EFFICIENCY

with an

edge moor radiant boiler

This installation covers two boiler units installed in a large southern plant. Each unit delivers 135,000 lbs. steam per hour at 300 lbs. pressure, final steam temperature of 575 degrees. Unit is fired with a multiple retort underfeed stoker and equipped with an Edge Moor vertical tube integral economizer.

To give you *more* power efficiency, Edge Moor Radiant unit design embodies all the advantages of a 3-drum boiler with a water-cooled furnace and maximum boiler tube surface exposed to radiant heat . . . all in a minimum of space.

This is the result of the combination of engineering skill and expert workmanship that for over three-quarters of a century have distinguished all Edge Moor products.

This arrangement provides for a large water storage, a generous steam liberation surface and quiet offtake drum. Furnace cooling is disposed for a minimum of maintenance and the best operation for the particular fuel to be burned. The ability of these units to steam quickly and deliver high ratings is a matter of record. Edge Moor Radiant Heat Boilers are available in a wide range of capacities, pressures and total temperature requirements. They are adaptable to all fuels and can be supplied with all boiler auxiliaries.

EDGE MOOR IRON WORKS, INC. Main Office and Works: Edge Moor, Del. Branch Offices and Agents: 95 River St., Hoboken, New Jersey • 7 Water St., Boston, Massachusetts • P.O. Box 9, Station E., Atlanta, Georgia • 2459 Woodward Ave., Detroit, Michigan • One N. LaSalle St., Chicago, Illinois • 2295 University Ave., Saint Paul, Minnesota • 623 Aztec Building, San Antonio 5, Texas • 141 Second St., San Francisco, Calif.

edge moor enerating equipment

EM

It didn't happen...BUT

DURING the war the Metropolitan District Water Supply Commission of Boston was prepared to meet the emergency which *could* have occurred if its Chestnut Hill Pumping Station had been bombed or sabotaged.

Within an exceptionally short time . . . in a comparitively small space . . . the Commission built an emergency pumping station which had an available capacity of 45 million gallons daily in case of necessity.

To accomplish this, two Warren 18-DL-25 pumps were used, one direct-connected to a 900 HP motor and the other V-belted to a 1250 HP motor (see illustration). These pumps were originally built by Warren for de-watering service in the Quabbin Tunnel project of the Metropolitan District Commission. Thus Yankee ingenuity, plus the versatility of Warren Pumps and Warren engineering, made another worthwhile wartime contribution.

The same product and engineering skill is now available for peacetime projects. Ask for information.

If you have a pumping problem involving:

- ☐ General Water Service
- ☐ Boiler Feed
- ☐ Paper Mill Services
- ☐ Process
- ☐ De-watering
- ☐ Condensate Return
- ☐ Oil Handling
- ☐ Hydraulic Pressures

. . . or other services, your inquiry will receive prompt attention.

P2

WARREN STEAM PUMP COMPANY, INC. - - - WARREN, MASSACHUSETTS - - - *Able Representatives in Principal Cities*

WARREN PUMPS

HOW TO TRAP BIG CONDENSATE LOADS

for quick removal of both air and water—

...use an ARMSTRONG COMPOUND TRAP

The Armstrong Compound Trap is an ingenious development which has met with wide favor in handling big condensate loads such as may be produced by steam purifiers, separators, flash tanks, heat exchangers, evaporators, and other big units. The design of the trap is very simple — a standard trap mechanism is used as a pilot valve to open a large discharge port. You get all of Armstrong's outstanding advantages: *self-scrubbing . . . non-airbinding . . . big air-handling capacity . . . long life parts . . . no springs . . . complete satisfaction.* Ask for interesting descriptive literature. Engineering recommendations on request.

ARMSTRONG COMPOUND TRAPS are built in four sizes . . . 1", 2", 3", and 6" pipe size connections . . capacities up to 300,000 lbs. of water per hour . . . operating pressures up to 600 p.s.i.g.

ARMSTRONG MACHINE WORKS
810 MAPLE STREET • THREE RIVERS, MICHIGAN

ARMSTRONG *Inverted Bucket* **STEAM TRAPS**

Over a Million in Use...For Power...Process...Heating

WATER TREATMENT RESULTS IN HIGH PRESSURE BOILERS

take more than high pressure selling

says: J. S. Colpage

Nalco Representative, The Flo-Control Company, Inc.
Oakland, California

DEVELOPING successful water treatment for high pressure boilers is a job for research chemists and engineers—not salesmen. Steam and water in high pressure systems are different—both in physical characteristics and in reactions involving scaling, corrosion and foaming. These differences are familiar to Nalco scientists—and are the reason that the Nalco System of Scientific Water Treatment in high pressure power plants is as effective and economical as it is in thousands of medium and low pressure installations.

Ask your Nalco Representative for details on a complete Nalco Survey for your plant . . . Or write direct.

Closeups of the peep-hole in one of the Nalco Laboratory test boilers are shown below. At top is water and steam at 250 lbs. p. s. i. Note the sharp line of water and steam separation, indicating high water density; low steam density.

At bottom is a test at 750 lbs. p. s. i. Water density is much lower; steam density higher. Different Nalco treatments for each pressure produced dry steam in both tests—Neither test could be successful without fitting the treatment to the pressure as well as the water and boiler conditions present.

The Scientific System of Water Treatment for All Industry

Nalco

NATIONAL ALUMINATE CORPORATION
6224 W. 66th PLACE • CHICAGO 38, ILLINOIS

Canadian inquiries should be addressed to Aluminate Chemicals, Ltd., 555 Eastern Avenue, Toronto, Ontario.

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILERS

1 **Scotch Marine Boiler Bulletin**—Catalog 99d contains four pages and describes this company's "Scottie Junior Boiler" a new small size which has been added to this line and which is designed for 100 lb pressure and with steam rating of 840 to 4200 sq ft. The bulletin presents all needed information including blueprint illustrations of both the coal and the oil and gas fired units. Tables of specifications are given and photos illustrate outstanding features. The last page of the bulletin shows other boilers in the company's line and presents tables of specifications for these units. Kewanee Boiler Corp.

2 **High Pressure Portable Boilers**—A four-page bulletin B-3025 is devoted exclusively to a description of this company's Series RP portable firebox boilers which are designed for high pressures and for burning any fuel. A large table gives complete specifications of the 13 models in the line, from the square feet of heating surface to the stack height. Line drawings are also presented which show the boiler arranged for stoker firing and for oil firing. Outstanding features of the unit are given in brief form. Titusville Boiler Division, Struthers Wells Corp.

AUXILIARIES, ACCESSORIES

3 **Coal, Ash Handling and Storage**—Sixty pages are included in this booklet on coal and ash handing and storage equipment. The booklet starts off with diagrams of silo storage systems and alternate methods of delivery to stokers and alternate methods of feeding the silos. Next are presented "Typical Coal Handing Systems . . " and "Typical Coal and Ash Handling Systems. . . " Photos and diagrams of plate feeders, vibrating feeders, apron feeders, bucket elevators, tables of specifications are given. Drive arrangements for standard elevators, safety ladders for standard elevators, chutes for standard elevators are features of the book. Belt conveyors, idlers, spiral conveyors, drag chain ash conveyors and others are included. The booklet is exceptionally well illustrated with drawings and photos. The Jeffrey Manufacturing Co.

4 **Combustion Data**—The first ten of a series of "Combustioneering" data sheets in loose-leaf form are now available. Especially prepared for combustion and process engineers, these ten sheets give mathematical tables, properties of gases, metals and other materials, and gas orifice capacity tables which are intended to bring together useful gas combustion and industrial heating data not readily available in a single reference source. Additional sheets will be published from time to time. Industrial Division, Bryant Heater Co.

5 **Underfeed Stoker Firing**—Reference Bulletin No. 8 covers the subject of achieving flexibility with multiple retort underfeed stokers. The bulletin presents a careful analysis of the factors involved in the selection of multiple retort stokers with emphasis on water cooling. The booklet is filled with design data and drawings of typical installations. Fairmont Coal Bureau.

6 **Pulverized Coal Data Book**—This 97-page, Bulletin No. 44-B, starts off with an analysis of the outstanding essential features necessary to secure efficient results from the use of pulverized coal. Immediately following this section, the bulletin describes in detail the operation of various types of mills, discusses their lubrication, covers the electric eye type of mill level control, and presents diagrams of various types of burners. Other equipment described includes disc feeders, fans, coal or shale crushers, coal-steam generators, furnace walls and doors. Cross-sectional illustrations of various types of boiler installations are presented and "before and after" drawings of modernization jobs are given. A large part of the remainder of the bulletin is devoted to descriptions and photographs of typical installations. An exceedingly useful section consists of several tables which give cost data and efficiency information. Kennedy Van Saun Mfg. & Eng. Corp.

7 **Non-Return Traps**—Bulletin P:406 is an engineering information bulletin which also contains a section on repair and replacement parts for this tilting type non-return trap and a description of the company's parts service. A full page of qualifications of an efficient non-return trap are presented and another full page is devoted to a listing of applications in which this trap has been outstandingly successful. Important considerations in steam trap selection are accompanied by trap capacity table and dimensioned drawings and tables of the company's trap. The bulletin is extremely well illustrated and contains 8 pages. Morehead Manufacturing Co.

8 **Oil, Tar, Gas Burners**—This is a 52-page collection of full-page illustrations and blueprint reproductions of the company's line of burners and burner accessories and parts. The drawings, for the most part, show details of construction and, in some cases, the various parts are listed. The last four pages in the booklet cover industrial burners for liquefied and gaseous fuels. W. N. Best Engineering Co., Inc.

9 **Fuel Saving by Tube Shaving**—"How Much Heat is Going Up Your Chimney . . . Wasted?" is the question asked by the title of this new 4-page bulletin on tube shavers. Losses from soot are clearly shown in tables. A complete description of the shaver is given on the following pages; the descriptive matter shows how four blades are first used on exceedingly dirty tubes with additional blades being added in succeeding steps in order to completely clean the tubes. Prices of the shaver are given and details of a free trial offer are explained. Goedert Flue Shaver Company.

10 **Plastic Super-Refractory Surfacing Mortar**—Bulletin 315E is a 4-pg folder describing Q-Chromastic, which provides armor-plate protection for furnace brickwork. The folder contains photographs showing the application of this product to the wall of a marine watertube boiler, to an eroded furnace wall, to an oil-fired marine boiler and several other applications. The bulletin tells how this product is used and how its use resists slagging action, flame erosion, corrosive gases and abrasion. It resists temperatures up to a softening point of approximately 3300 F and reduces spalling troubles. Quigley Co.

PUMPS, COMPRESSORS

11 **Multi-Stage Pumps Bulletin**—Bulletin 103 is an 8-page catalog covering the company's single suction, multi stage pumps. Details of construction and exterior and cross sectional views of the units are presented and a cross-sectional line drawing shows the parts. Under the heading "Points Worthy of Careful Consideration," are presented results of tests plotted in a chart and a listing of certain features of the units. Frederick Iron & Steel Inc.

12 **Steam-Driven Compressors** — Bulletin L-680-B1A is a 32-page issue which covers the company's steam-driven opposed compressors, 4 models. The various construction features of these units are dealt with in detail; one instance, the feather valve, has two pages which cover its features and operation. All illustrations in the book are large and clearly depict the various parts of the equipment. Typical installations of the equipment are prominently featured. Worthington Pump & Machinery Corp.

13 **Water Supply and Pump Data Book**—This engineering data book is chock full of information needed in calculating water booster systems and in specifying the equipment for the job. The contents include charts and tables of head and capacity requirements, table of friction of water in pipes, typical installation blueprints, head-capacity selection charts, approximate dimensions for floor space requirements, typical company installations and two pages of typical specifications for pneumatic type systems and gravity type systems. The booklet is well illustrated with photos, charts and drawings. Yeomans Brothers Co.

14 **"Pump Valve Service"** — Catalog No. 920, designed to illustrate the wide application of this company's valve units for reciprocating pumps and Diesel engines, has just been issued. The appli-

NOVEMBER, 1946

POWER PLANT ENGINEERING

53 W. Jackson Blvd.
Chicago 4, Illinois

Please have the manufacturers send me without obligation the literature indicated by the following paragraph number.

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Please Print Clearly

Your Name .....

Your Title .....

Your Company Name .....

Company Address .....

City ..... State .....

(If you prefer delivery at your home also fill in below)

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City ..... State .....

cations illustrated in this bulletin are primarily on pumps and Diesel engines which use these valves as standard equipment, but the details presented not only provide a summary of the design characteristics of the valve but also show their adaptability for use as replacement units on any type of reciprocating pump. Durabla Mfg. Co.

15 **Controlled Volume Chemical Pumps**—This is a 4-page folder, Bulletin No. 468, describing the company's controlled volume chemical pumps and automatic chemical feed systems of which these pumps are an integral part. The folder describes in considerable detail the application of these pumps and systems to automatic proportioning and ratio control systems, automatic pH control and automatic control by temperature, pressure, conductivity or liquid level. The bulletin is well illustrated with photographs. The last page presents three photo-diagrams which show the application of the pumps to automatic proportioning systems and to automatic pH control. Milton Roy Co.

16 **Self-Priming Centrifugal Pumps**—This 19-page booklet has been prepared by A. S. Marlow, Jr., for engineers, factory managers, maintenance men, contractors, salesmen, students and all who are interested in following the progress of centrifugal pumps. The booklet gives a brief history of centrifugal pumps with simple line drawings illustrating the relation of centrifugal pumps to the old trick of swinging a pail of water upside down without spilling any. It explains in an easy-to-understand manner the science of centrifugal action and the physics of centrifugal pumping; tells how self-priming centrifugal pumps operate; shows how they are constructed, gives performance curves and tells where these pumps are used in industry. It is extremely well illustrated and should be of interest to anyone who is responsible for the operation and maintenance of this kind of equipment. Marlow Pumps.

17 **HP Pumps Catalog**—Catalog D-446 is a newly issued four-page bulletin which tells about this company's line of small, high pressure pumps for pressures up to 200 psi. Details of construction and design are accompanied by a sectional drawing of the unit. Charts of capacities at various heads and pressures assist in the description and specification of these units. Another chart shows the suction heads required for multistage pumps handling hot water at various temperatures. Economy Pumps, Inc.

WATER CONDITIONING

18 **Boiler Scale Studies**—Containing sixteen pages and liberally illustrated is this reprint of a paper presented before the Sixth Annual Water Conference by this company's Messrs. Holmes and Jacklin. The paper describes the conditions under which the tests were conducted and briefly reviews a paper presented earlier. These later tests were conducted in a new type boiler at 1500 psi. Differences in the effect of organic treatment between 800 psi (the pressure at which the first tests were conducted) and 1500 psi are shown. Other factors investigated were the effects of iron, effect of variation of calcium-magnesium in feedwater, reduction of silica by magnesium, etc. Prepared discussions by Messrs. Imhoff, Webb, Scott and McIlroy are presented. National Aluminate Corp.

19 **Dry Water Treatment Compound**—"Dry Pink" this company's name for its dry ingredient for boiler feedwater treatment is described in this four page bulletin. The bulletin presents "ten basic facts" concerning the material and also describes briefly the company's service. A trial offer of the treatment is also outlined. Dominion Chemical Company, Inc.

20 **Feedwater Control Service**—There are 12 pages in this paper-bound booklet telling about the company's supervision and control of feedwater. The book follows orderly progression in its explanation of the available services. It first tells the need of the service and what it consists of and outlines the treating program and the equipment used. Instructions for the plant operator, description of the chemical feeding equipment and the control of this equipment are given generous treatment. Other subjects covered are operation of external softeners, steam quality and blowdown control, embrittlement of boilers, chemical cleaning of boilers and special problems. Cyrus Wm. Rice & Co., Inc.

21 **Hot Process Water Treatment**—Form 326 is a case study bulletin; it tells about the results of an installation of the company's hot process water treatment equipment at the Kankakee Ordnance Plant at Wilmington, Ill. The system was designed to provide 60,000 gph of properly conditioned water, free from hardness, scale forming minerals and corrosive gases. The bulletin presents several excellent photographs of the installation and also a schematic diagram of the installation with the flow of water indicated. Graver Tank & Mfg. Co., Inc.

22 **Corrosion and Scale Control**—The current issue of H-O-H Lighthouse recognizes the fifteenth anniversary of this company. Two interesting articles also appear in this issue; both are informatively written with a view to acquainting the reader with several common and uncommon applications of organic chemicals (Glucosates) to widely diversified water-treating problems. D. W. Haering & Co.

TUBING

23 **Tubing Technical Bulletin** — Revised Technical Bulletin 746 is concerned with the physical and chemical properties and methods of installation of these duplex tubes—tubes which are made up of inner and outer parts of different materials designed to resist different corrosive materials. Heat transfer test tables, combinations of metal in which the tubing is available, possibilities of expanding, rolling-in, bending and joining tubing and other data are presented in one part of the booklet. Under "Methods of Installing Duplex Tubing" are covered such considerations as the tightness of the tubes in the tube sheet, provision for thermal expansion, provisions for reducing turbulence and others. This section is well filled with line drawings. Bridgeport Brass Co.

24 **Tube Problems Handbook** — Containing everything about tubing from the history of condenser tubes to various methods of manufacture, this 32-page, paper bound booklet should prove of great interest and usefulness to all plant engineers. A mere recital of the contents of the book will not give evidence of the scope of the material. Covered are Tube Corrosion Problems; Types of Water; Corrosion Outline; Destructive Cavitation; Deposit Attack; Galvanic Action; Intercrystalline Corrosion and Dezincification. Methods of Manufacture, ASTM Specifications, Laboratory Testing, Service Experience, Physical Properties, and Weights and Surface Areas also are given. Many tables and photographs aid in making the description clear. Chase Brass & Copper Co.

25 **Tube Expanders**—This four-page folder, Bulletin No. 30, covers the company's line of tube expanders. A general description of tube expanders is followed by illustrations and brief descriptions of heat exchanger and condenser tube expanders, boiler tube expanders and drives and universal joints. Airetool Manufacturing Co.

ELECTRICAL

26 **Illumination Design Data**—Information for designing interior lighting installations is contained in a new 8-page folder A-34639. Essential information is contained in easily-read tables covering popular types of luminaires, lamps and ballasts. Special emphasis is placed on maintenance with a range of values being given for each luminaire. This enables the designer to make an intelligent estimate of the depreciation which may be expected under good, medium and bad maintenance conditions. In addition to the generally used methods of determining average illumination values, tables and curves are given which will permit the calculation of illumination at various points when produced by a direct lighting unit such as the reflector or projector lamp. Westinghouse Electric Corp.

27 **Continuously Adjustable Transformers**—Here is a recently-issued bulletin telling about this company's new 10-ampere Variacs for manual control of line voltage. As pointed out in the bulletin there long has been a gap between the conventional 5 amp and 20 amp adjustable autotransformers. The output voltage of these new Variacs is reported to be from zero to 17 per cent above line voltage. The bulletin gives complete descriptions and specifications of the units and includes their prices. A full-page table is also presented in order to help in selecting the proper type of unit. General Radio Co.

LUBRICATION

28 **Lubricants Service Handbook** — There are 28 pages in this recently issued booklet on lubricants and their application. The development of the lubricant, its features and advantages and the manner in which it meets various operating conditions take up the fore part of the booklet. Two pages are used to cover definition of the various types of lubricants in the line, both fluid and grease type. "Application of Lubriplate Lubricants" is a useful section of the book; it shows and tells by sketch and description where the various lubricants should be used and why. The most useful part of the book is the "Recommendations" section where the manufacturer tells just what grease or oil should be used according to speeds, temperatures, pressures and general service conditions. Fiske Brothers Refining Co.

29 **Specialized Industrial Lubricants**—Water repellent qualities of these lubricants combined with their high film strength at low viscosity are shown, in this booklet, to be two outstanding reasons for the successful application of these lubricants to all types of industrial machinery. Examples of the use of various of these specialized lubricants for such equipment as hydraulic systems, for open gears, enclosed gears, flexible couplings, for wire rope, worm drives, etc., are presented in brief form. Two pages of descriptions show how the company's "know-how" has solved many an industrial problem is another feature of the bulletin. The Brooks Oil Co.

30 **Lubrication Handbook**—Technical Bulletin B-1 is a revised edition of this company's "Lubrication of Diesel Engines," a 50-page handbook which covers all phases of the subject. The chapter headings illustrate the scope of the book—Development of the Diesel Engine, Common Types of Diesel Engines, Explanation of Combustion Process, Modern Fuel Injection Systems, Accessories, their Design and Use, Cylinder and Bearing Lubrication, Lubricating Oil Recommendations, and Filters—Strainers—Reclaimers. Starting and ignition systers are covered as are supercharging, Diesel fuels, and maintenance and operation of Diesels. Trouble-shooting chart and viscosity-temperature charts also are presented. Sun Oil Co.

(*Continued on Page 152*)

UNION "O" TYPE BOILERS

ONE OF 13 TYPES COVERED *in this book*

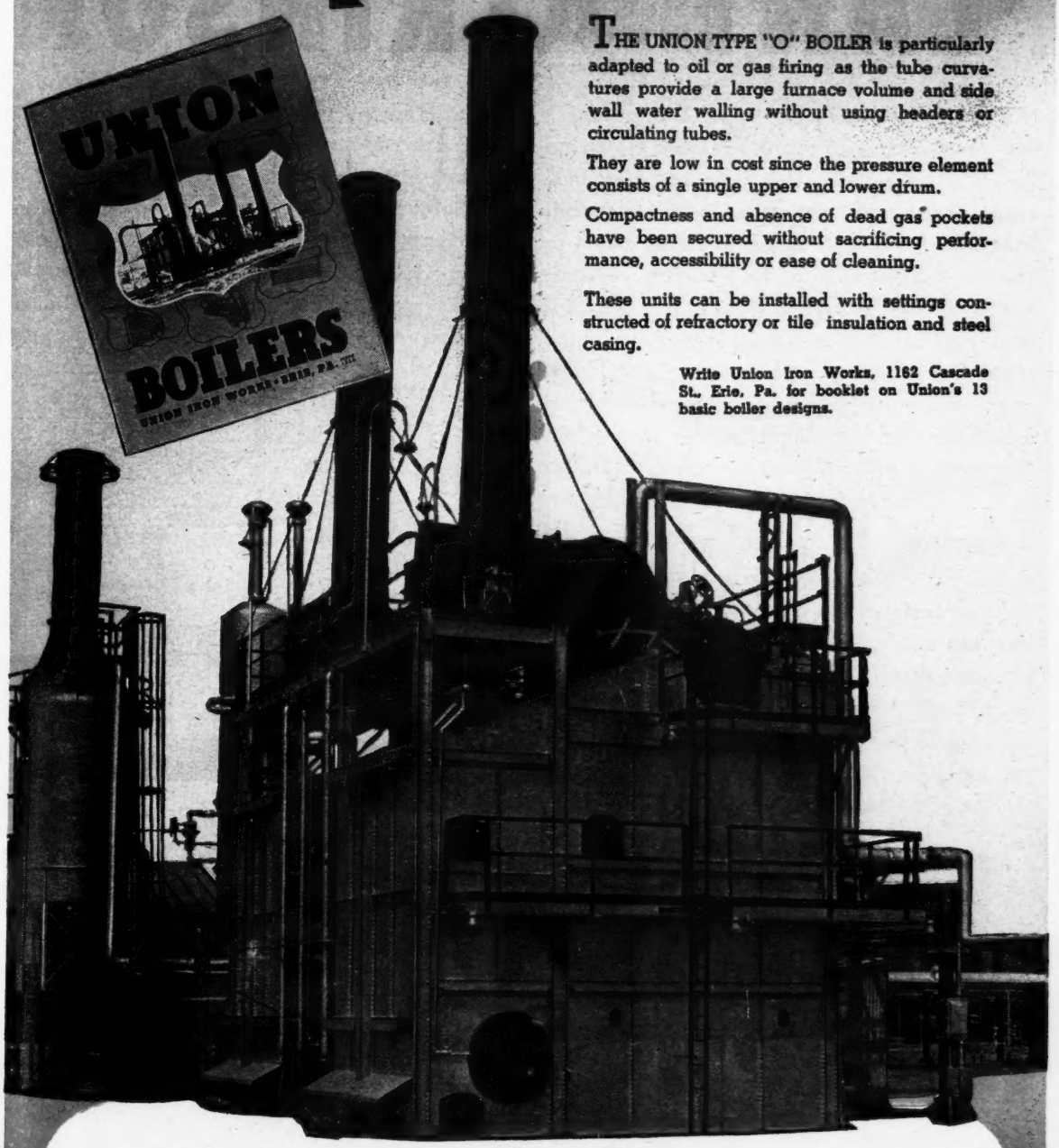
THE UNION TYPE "O" BOILER is particularly adapted to oil or gas firing as the tube curvatures provide a large furnace volume and side wall water walling without using headers or circulating tubes.

They are low in cost since the pressure element consists of a single upper and lower drum.

Compactness and absence of dead gas pockets have been secured without sacrificing performance, accessibility or ease of cleaning.

These units can be installed with settings constructed of refractory or tile insulation and steel casing.

Write Union Iron Works, 1162 Cascade St., Erie, Pa. for booklet on Union's 13 basic boiler designs.



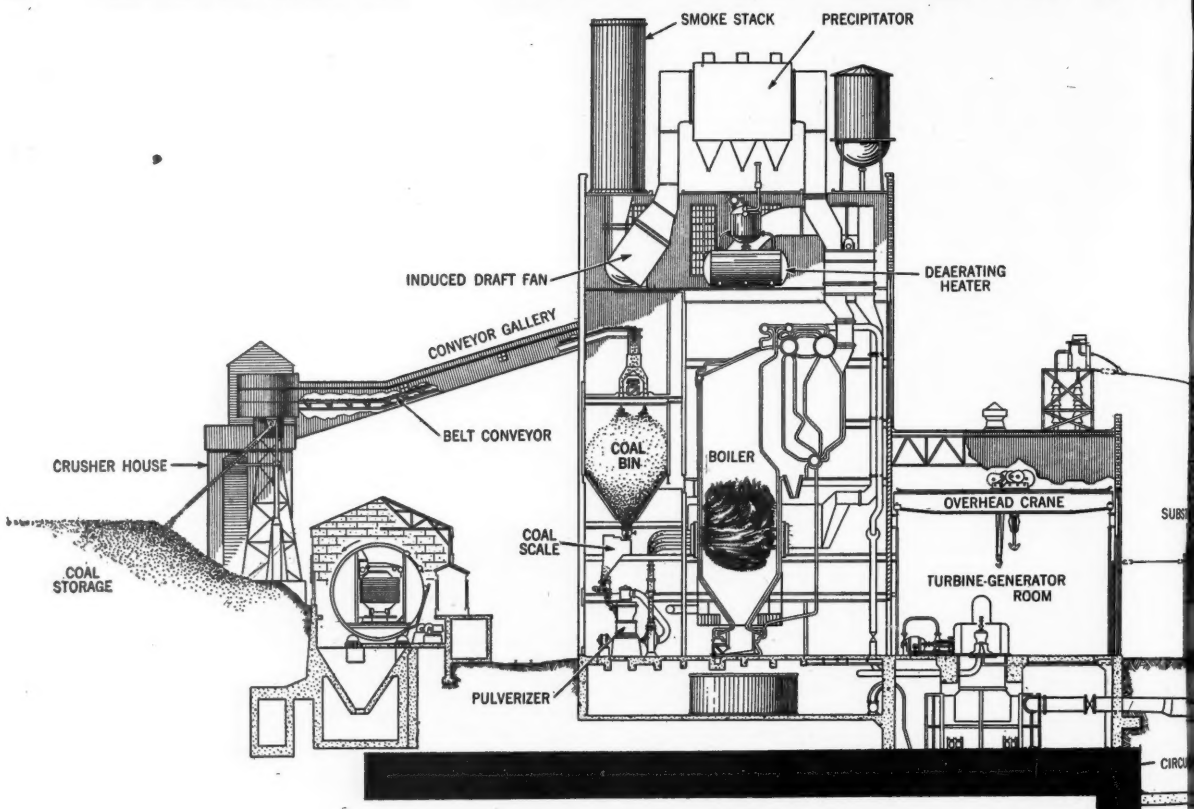
UNION IRON WORKS • ERIE, PA.

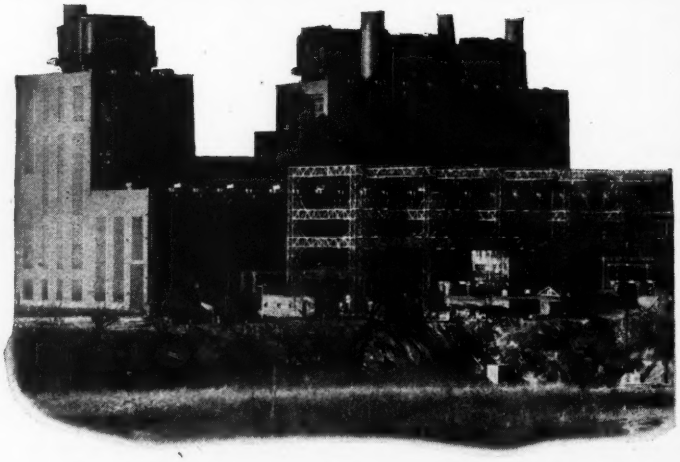
Since 1890

BOILERS — PROCESS EQUIPMENT — FABRICATED STEEL

Georgia Power's

PLANT ATKINSON

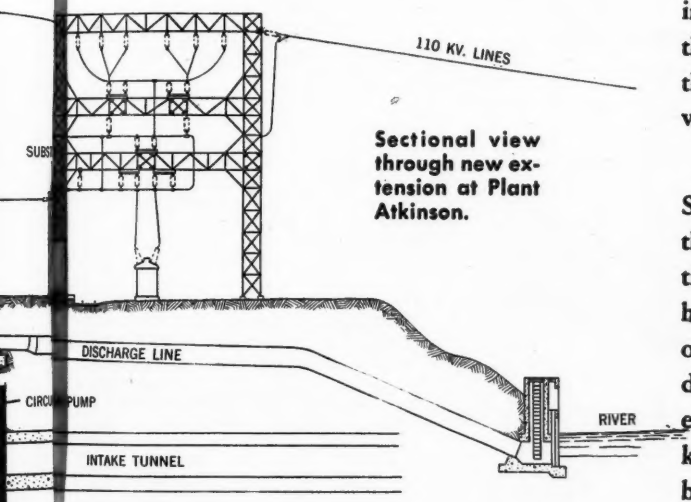




Plant Atkinson—latest extension is the building on left side of photo.

A Case History of Progress

PLANT Atkinson is now the largest in the Georgia Power Company system. The Station was begun in 1929 as a link in the state-wide electric power facilities envisioned by the late Henry Morrell Atkinson, in whose honor it was named. Brought to its present capacity in three steps, the first section comprised a 60,000 kw turbine-generator served by two C-E Sectional Header Boilers, each designed to produce 375,000 lb of steam per hr at 425 psi and 725 F at the throttle.



Sectional view through new extension at Plant Atkinson.

By the time the first addition was planned, modern designs of steam generating equipment had established service records comparable to those of turbines. So the second 60,000 kw machine was served by a single C-E Bent Tube Unit of 650,000 lb capacity for the same pressure and temperature conditions.

Late in 1945 the second addition was placed in operation. Studies, prior to its authorization, had confirmed the one-boiler, one-turbine plan but dictated the use of higher pressure and temperature to obtain better economy. Accordingly, the new 60,000 kw turbine is served by a 600,000 lb capacity C-E Unit similar to its immediate predecessor but built for 975 psi (design pressure), and 900 F total steam temperature. Furthermore, the new boiler incorporates improvements in design that reflect the progress and development of the period since the previous unit was installed. The station is pulverized coal fired using C-E equipment.

In a recently published article on the Atkinson Station the author concluded, "The third unit in this plant is now in regular and continuous operation. Performance of the plant to date has been highly satisfactory with respect to convenience of operation as well as overall economy. The original design contemplated an average full load station economy of approximately 12,500 Btu per net kwhr, but it is likely that the actual economy will be nearer 12,000 Btu per net kwhr." A-954

C-E

COMBUSTION ENGINEERING

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E PRODUCTS INCLUDE ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; ALSO MANY TYPES OF PRESSURE VESSELS

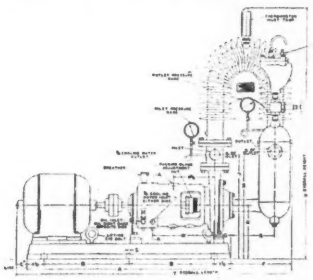
NEW EQUIPMENT NEWS

The new equipment items in this section are identified by letters which precede the headings. When further information is desired regarding any of this equipment write this corresponding letter on the coupon in the Helpful Bulletins section, cut it out and send it to Power Plant Engineering, 53 West Jackson Blvd., Chicago 4, Ill.

A Condensate Return System

The Cochrane C-B (for Condensate-Booster) high-pressure condensate return pump has been redesigned for greater operating freedom. A new larger pump driven by a 25-hp motor has been added to handle capacities previously impossible with the 3, 5, 7.5, 10 and 15-hp units. The outboard pump shaft bearing has been eliminated in favor of closer coupling. A better-adapted flexible coupling between pump and motor is being employed. A silent jet permits more convenient installation since pump noise is no longer a factor.

The specially designed centrifugal pump draws water from the thermo-fin priming loop and discharges it as high velocity jet through the jet pump nozzle. This jet



strikes the returned hot condensate flow through the Venturi-shaped mixing tube and into the thermo-fin priming loop. The additional volume of condensate introduced into the constantly filled loop results in the discharge of an equal volume through the air separator to the boiler.

The hot condensate and entrained air are drawn rapidly and positively from the processing equipment by the jet pump. Air is eliminated from the circuit in passing through the air separator and the condensate is returned to the boiler at maximum temperature and pressure. Thus the circuit from boiler, through equipment, and back to boiler, is completed in a closed system without substantial drop in temperature. Performance of the unit is verified by the pressure gauge on the inlet together with the pressure gauge and thermometer on the outlet.

B More Regal Oils

Announcement of three additions to the well known Regal Oils (R&O), which are designed for turbines, hydraulic and circulating systems, is made by The Texas Co.

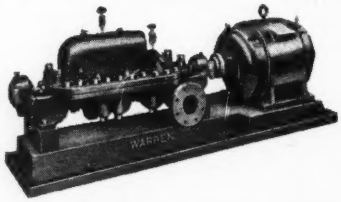
The new lubricants are classified as Regal Oils (R&O) AZ, F, and G. Regal Oil (R&O) AZ is suitable for use in hydraulic equipment in sub-zero temperatures, and F and G are developed for use in mills where rust and oxidation inhibited oils of corresponding viscosity are needed.

The Regal Oils (R&O) are rust and oxidation inhibited oils which prevent clogging of oil lines, scoring of journals, and sticking of governors in marine and stationary turbine installations as well as rusting and sludging in hydraulic and circulating systems at both idle and operating temperatures.

Incorporation of certain chemical additives having no undesirable effect on the base mineral oil aids the improved Regal Oils in resisting oxidation and preventing rust formation, and gives both stability after long time storage and long service life. The oils separate easily from water, do not foam, and are non-corrosive to bearings. The rust inhibitors "plate out" on metal surfaces, forming a film impervious to the rusting action of moisture and air. Even after considerable periods of service, the oils still pass rusting tests with distilled water and synthetic sea water. Tests have shown the new oils to be many times more resistant to oxidation than turbine oils not containing inhibitors.

C 4 and 6 Stage Pumps

Warren Steam Pump Co., Inc., has just announced these 4 and 6 stage pumps designed for boiler feed and other high pressure services. The pumps are available in capacities from 40 to 750 gpm against heads of from 700 to 1600 ft.



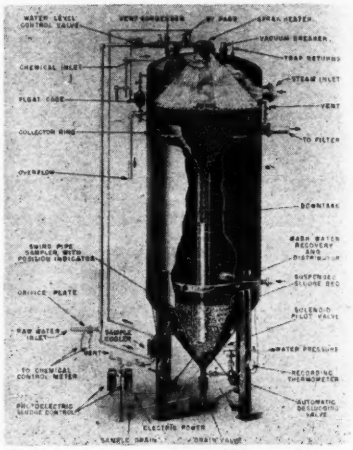
They are produced in 1½, 2, 2½, and 3 in. discharge sizes for both the four and six stage units. The company points out that bronze fitted pumps are standard but that various metals can be furnished for special applications.

D Hot Process Water Softener

Improved boiler feedwater and substantial savings in chemicals required for water softening are two chief features of a new type of hot process water softener, incorporating a sludge blanket design, which has been developed by The Permutit Co. This new equipment, built in four models for use with every type of steam generator, also reduces the turbidity of softened water, lessens the load on filters, reduces the amount of backwashing and lowers the amount of silica left in the water.

In the tank, suspended sludge forms a bed which acts as a filter screen for fine particles. This bed, coupled with the slow rate of upward flow throughout the full cross section of the settling tank, gives an effluent lower in turbidity than that obtained in older types of softeners. The low turbidity in the settled water places a relatively light load on filters and this in turn produces a corresponding reduction in frequency of backwashing.

When the sludge blanket has considerable



oxide or hydroxide of magnesium, a higher degree of silica removal is effected than was possible in earlier model softeners. Each particle of silica has an intimate and prolonged contact with the magnesia which removes silica by adsorption.

Another highly unusual feature of this apparatus is the automatically operated desludging valve which controls the depth of the sludge bed. The desludging valve is actuated by an electronic turbidity detector which continuously measures a water sample passing through the bed and between a light source and photo-electric tube. If the continuous sample of water has enough suspended matter to operate the sludge control unit, a solenoid valve is energized which, in turn, opens the desludging valve until the turbidity has been reduced to the desired value. Intervals between blowing off usually vary from one to eight hours dependent on the rate of flow of soft water required.

E Gas-Electric Drive Arc Welder

A compact combination drive welding machine consisting of the standard 300 amp generator and 20 hp induction motor mounted on a heavy solid shaft coupled to a 6 cyl Chrysler industrial engine through an overrunning clutch coupling is announced by The Hobart Brothers Co. This coupling allows the gasoline engine to drive the welding generator positively. Should the gasoline engine be stopped, however, and the generator driven by the electric induction motor, the clutch will over-run, or free wheel. This action is entirely automatic and no levers or pins are required to be moved.

The induction motor is wound for dual voltage 220/440. This change over is accomplished by throwing a double-throw

Look to LUNKENHEIMER *for* STEEL VALVES

2500-lb. S. P. Alloy Steel Gate Valve, with all-welded By-pass, welded in Seat Rings, Seal Welded Bonnet with Breech Lock, Welding Ends, Bevel Gear Drive.

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● Long skilled in the manufacture of valves and ever responsive to industry's needs, Lunkenheimer pioneered in the development of Steel Valves.

With the application of higher and higher temperatures and pressures, operating conditions became increasingly severe. Lunkenheimer was ready with valves fabricated from materials that met the most exacting requirements.

And as new problems arise, Lunkenheimer metallurgical research, engineering knowledge and specialized manufacturing facilities can be depended upon to aid in their satisfactory solution.

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Lunkenheimer manufactures a complete line of Bronze, Iron, and Steel Valves, Boiler Mountings, Lubricating Devices and Air Devices. Available from Distributors located in all industrial centers. There is one near you, fully equipped to assist with your (MRO) maintenance, repair and operating problems.

AT THE POWER SHOW — BOOTH 52

See the latest Lunkenheimer design of 1500-lb. S. P. Steel Breech Lock Gate Valves with Seal Welded Bonnet

In Attendance: FRANK P. RHAME, President; HARRY A. BURDORF, Vice-President in Charge of Sales; WM. CARSON, Sales Engineer; FRED H. HEHEMANN, Chief Engineer; JOHN W. BOLTON, Chief Metallurgist; ALLEN W. LANDER, Eastern Sales Manager; WM. J. ANGERT, Manager, New York Branch.

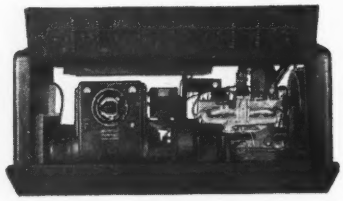
THE LUNKENHEIMER CO., Cincinnati 14, Ohio

NEW YORK 13, CHICAGO 6, BOSTON 10, PHILADELPHIA 7

EXPORT DEPARTMENT: 318-322 HUDSON ST., NEW YORK 13, N. Y.

knife switch either to the 220 v position or the 440 v position. The motor is started by means of a pushbutton across-line contactor which is designed to work in conjunction with the voltage changeover knife switch so that no changes are necessary in the contactor for 220 or 440 v operation.

The gasoline engine is furnished with an idling device and all other features of the company's standard 300 amp gas drive

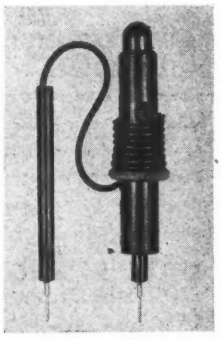


and of their 300 amp electric driven machine, plus the over-running clutch coupling and the 220/440 v changeover switch. This single-unit construction assures perfect alignment at all times which results in trouble-free operation. The clutch is practically wear-free, being of ball bearing construction with hardened races and sprags.

This unit is well adapted for specialized applications, as the operator will be able to take advantage of the cheapest power available, either 220 v or 440 v three-phase. If no electric power is available at the job site, or if a power failure occurs, the gasoline engine is there to fall back on. When used on a portable mounting the unit can be very valuable to large chemical, oil, steel and other industries whose equipment is spread over large areas and where power conditions vary over these areas.

F Combination Test Lamp and Voltage Indicator

This new test lamp and indicator recently announced by Holub Industries, Inc., is known as the "Hi" Tester and is an inexpensive pocket instrument which is designed to offer the ultimate in safety, reliability and efficiency. It is available in two models, 100 to 600 v, equipped with a filament lamp with only one test lead which prevents shorting out the resistor.



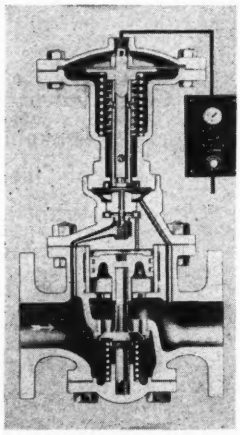
The "Hi" Tester is for use on a-c or d-c circuits to locate grounds, opens, blown fuses, motors running single phase, tracing controls and other circuits, and to indicate approximate voltage. It gives definite signals in brightly lighted as well as in dark places without confusion. No fuses are required for safety and both lamp and test lead are easily renewed.

G New Remotely Adjusted Regulating Valve

A new single-seated, internal pilot, piston operated reducing valve designed to be remotely adjusted from a conveniently located air loading panel, has been announced by Leslie Co.

Known as Class LT-3, this reducing valve with the Type ARP air loading panel is especially adaptable to process piping arrangements, particularly steam heating systems, that require hazardous or inconvenient readjustments of inaccessibly located valves to meet changing conditions. The air loading panel includes a small ⅛ in. combination pressure reducing and relief valve (no continuous leak-off) mounted on a panel containing an adjusting knob and a large, easily read air pressure gage.

In operation, the reducing valve is adjusted to the desired pressure setting by air pressure supplied by the air loading panel. The constant loading force on the upper diaphragm of the reducing valve opens the controlling valve and it is balanced by a constant reduced pressure pro-



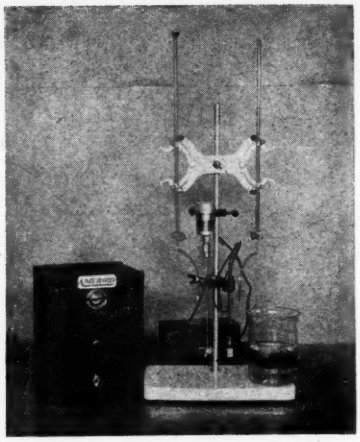
portional to the loading force, thereby maintaining a constant reduced pressure. Turning the adjusting knob on the air loading panel clockwise increases loading pressure and reduces steam pressure, while counter-clockwise turning decreases loading pressure and reduces steam pressure.

Furnished in high pressure bronze or cast steel body with flanged or screwed ends, these valves have completely interchangeable replacement parts, stellited seat rings, and hardened stainless steel 800 Brinell main valves as standard equipment.

H Plant Testing for Dissolved Oxygen

Corrosion of power plant equipment by water containing dissolved oxygen is a common experience. In order to counteract this corrosion, it is necessary to eliminate most, if not all, of the oxygen. To accomplish this and to be assured that an objectionable amount of oxygen does not remain, an accurate method for determining dissolved oxygen must be used.

The Winkler method is the basis for all modern tests but the use of starch as an indicator gives questionable results, this manufacturer contends, and furthermore it is difficult to distinguish the endpoint. Because of these objections modifications have been made by this company to increase the accuracy of the test. One of



the modifications that has found favor is the one based on the article by Ulmer, Reynar and Decker in ASTM Proceedings, Vol. 43, 1943, page 1258. This method corrects for impurities in the water and uses a "magic eye" type of endpoint instead of starch. At the exact endpoint, one drop of the titrating solution (0.002N) causes the eye to blink or close. There is no question as to when the endpoint is reached, no graphs or curves to draw as with potentrometric titrations. This apparatus is now being used in several large utilities for routine plant testing of oxygen.

Because of the wide interest in the method the apparatus is now being marketed, complete with instructions as to use. Industrial Department, E. F. Drew & Co., Inc., can supply further information and bulletins.

J Oil Seal Packing

A new type of oil seal packing, developed by the Johns-Manville research laboratories for the protection of bearings, was announced recently. Using no metal, the new oil seal has a high factor of heel rigidity and a soft flexibility. The new product is known as Clipper Seal and is made with a heel of resin-bonded fabric giving it the rigidity essential for a press fit in the cavity and with a lip of a

tough but soft flexible compound. The special lip design makes it possible to vary the bearing area and control the pressure of the lip against the shaft by means of

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SOURCE OF SUPPLY
RESPONSIBILITY
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To central stations and industrial power plants of today and tomorrow, Crane has a lot to offer. Now, when you're planning to rebuild or expand, count on the complete Crane line to help speed and simplify every step of piping procedures—from design to erection to maintenance.

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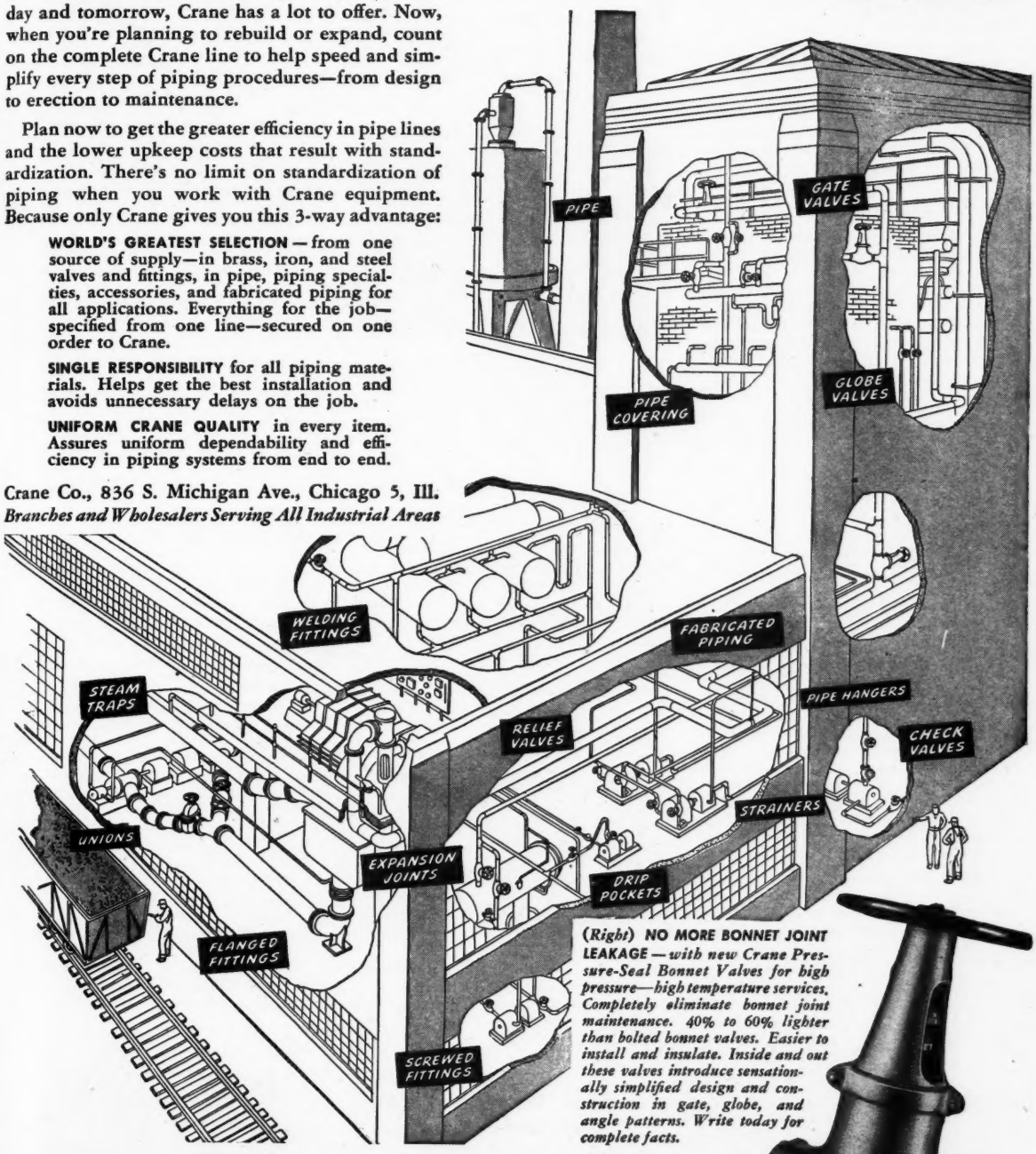

(*Right*) **NO MORE BONNET JOINT LEAKAGE**—*with new Crane Pressure-Seal Bonnet Valves for high pressure—high temperature services. Completely eliminate bonnet joint maintenance. 40% to 60% lighter than bolted bonnet valves. Easier to install and insulate. Inside and out these valves introduce sensationally simplified design and construction in gate, globe, and angle patterns. Write today for complete facts.*

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VALVES • FITTINGS
PIPE • PLUMBING
HEATING • PUMPS

CRANE

FOR EVERY PIPING SYSTEM

a garter spring, thereby reducing shaft wear to a minimum.

Its one-piece precision-body, concentrically molded and nonmetallic in construction, permits relatively liberal machining tolerances. Its compact shape makes possible a light flange section that effects compactness of machine design.

In service, these features provide a positive lubricant-retaining, dirt-excluding seal, automatic in operation, adaptable to a wide range of conditions, and highly resistant to most forms of corrosion.

Clipper Seals are made in sizes from 1 5/16 in. to 37-in. diameter, in both endless and split types. Special designs are available where unusual temperature, pressure or chemical conditions require.

K Stainless Steel Fittings One of the most complete lines of stainless steel welding fittings to reach the postwar market is now being manufactured by Tube Turns Inc., and is available through distributors located in all principal cities. The line includes 180 deg long radius returns, 90 deg long radius elbows, 45 deg long radius elbows, straight tees, reducing outlet tees, caps, eccentric

reducers, concentric reducers, lap joint stub ends, laterals and crosses, all in standard and extra heavy weights; and welding neck flanges, slip-on flanges, threaded flanges, blind flanges, socket-type welding flanges, reducing flanges, orifice flanges and lap joint flanges. Size range from ¾ in. through 12 in.

The fittings may be had in three grades of stainless steel; Type 304, containing 18 per cent chromium and 8 per cent nickel; type 347, containing 18 per cent chromium, 8 per cent nickel, and approximately 1 per cent columbium, and type 316, containing 18 per cent chromium, 8 per cent nickel and 2 per cent molybdenum.

L New Jet Mixer A new liquid mixing eductor which utilizes the jet principle to mix, blend or emulsify two liquids is offered by Schutee & Koerting Co. Simple in construction with no moving parts, the SK Mixing Eductor requires little space, is inexpensive and can be made of almost any material to adapt it to special conditions or processes.

In operation, the pressure liquid issues from the jet orifice at high velocity and entrains the secondary liquid. Extreme turbulence, resulting from the impact of the two liquids, produces a thorough and complete union of the liquids. Close regulation can be obtained if necessary by a valve in the pressure liquid line or the installation of an SK gear pump in the suction line.

The SK Mixing Eductor has many uses, from treating water in purification plants or proportioning chemical solutions, to adding liquid foam agents in high pressure fire lines or blending oils for special purposes, and new uses are constantly being found.

M Heat Resistant Packing This new packing consists of a soft core of asbestos with a wire-inserted asbestos cloth folded over the exterior. It is impregnated with a special binder, and the typical tadpole-like cross section is the result of the cloth ex-

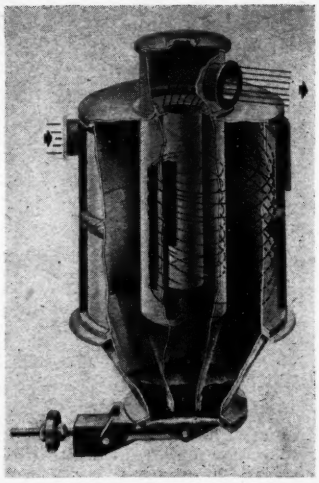
tending to one side. This forms a flange for riveting or securing the gasket, yet leaves the round portion as a cushion upon which the door or cover closes. Raybestos-Manhattan engineers offer this new Tadpole packing to provide a tight seal on furnace doors wherever heat-resistance is important, but flange pressure is not great.

N Ring Gaskets Forged gaskets for valves, valve bonnets and flanged connections are now available in two types, (Type O) oval, and (Type X) octagon and in a wide range of sizes including all standard API sizes. They are made by The Steel Improvement & Forge Co. for high pressure and high temperature pipeline use wherever ready disassembly is required. Forged of different metals to meet the requirements of different service

conditions, these ring gaskets provide for making a connection, by wrench pressure, as tight as a weld. They are forged in closed impression dies and then machined to assure exact dimensions for all services.

O Ash Receiver and Separator A new ash receiver and separator, a refinement for the pneumatic ash removal system, is announced by the Beaumont Birch Co. Of cyclone construction, its features include: maximum separation of ash and dust from air; multiple settling cones with single, vacuum-operated, loaded-weight discharge gate; and internal freedom from moisture.

Air, bearing ash and dust is drawn into the unit by suction produced by a steam exhauster. The air and ash impinge against a heavy duty, removable plate. The whirl-

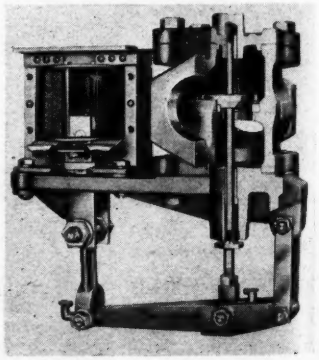


ing motion imparted by the concentric construction of the separator causes the solids to be thrown against the sides by centrifugal force. The resultant impact slows the particles sufficiently for them to drop down into the section where the air is inactive. The inactive area is maintained by louvers located in the upper part of the second and third cylinders which limit air movement to the upper area. After going through the three stages, air is drawn out the exhaust pipe through the top.

The roller-bearing hinged gate attached to the bottom is actuated by the vacuum created by the intermittent operation of the steam exhauster. It closes when under vacuum and opens automatically when vacuum is released.

P Direct-Acting Solenoid Valve With the development of this new solenoid valve, the Johnson Corp. has now made the advantages of an automatic electric valve available for a wide range of applications. The new valve combines immediate full flow with the ability to operate under differential pressures as high as 150 lb. It can be used for all types of liquid level control, with hot and cold water, steam, oil and other processing liquids.

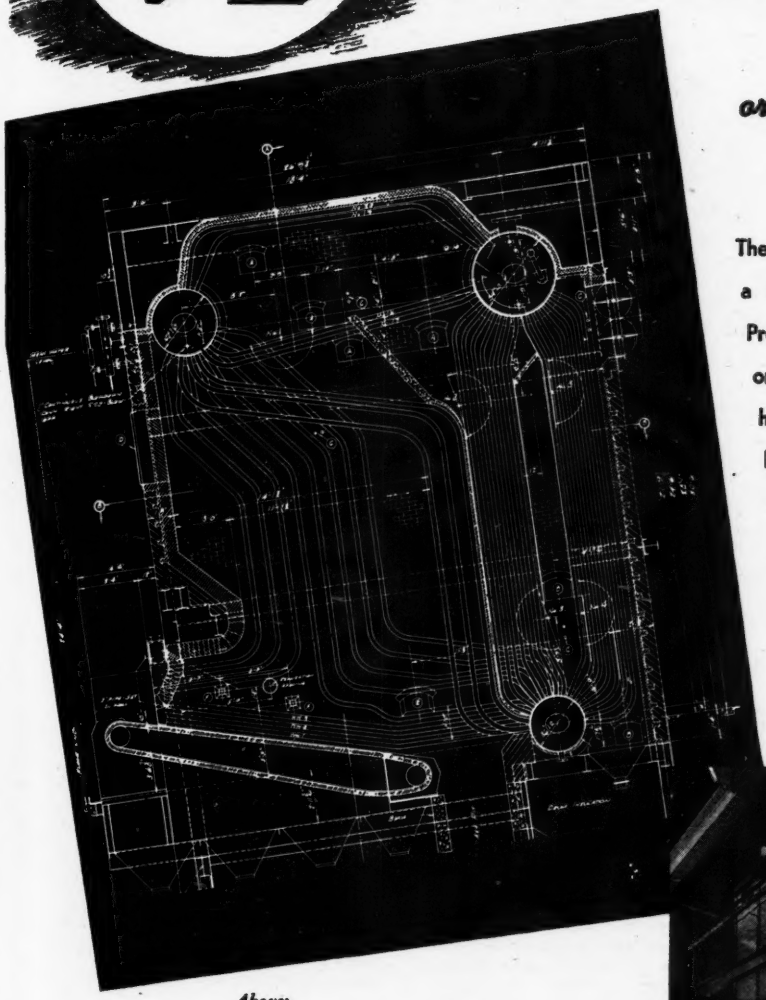
This new valve is direct-acting—not pilot operated. The solenoid is conservatively rated and an ingenious lever arrangement provides ample power to insure positive opening of the valve. This single seat construction, the manufacturer points out,



CLASS **VL**

Vogt Steam Generating Units

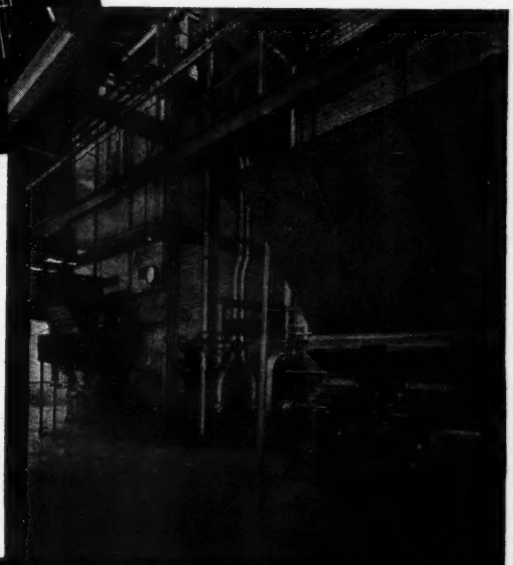
for POWER *or* PROCESSING LOADS, *and* HEATING



The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.

Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.



HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas

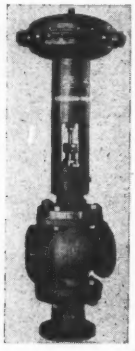
eliminates the trouble sometimes encountered with pilot operated valves when silt or other foreign matter freezes the piston. It also greatly increases the temperature range—enables it to handle hot liquids or steam up to 365 F.

In normal position the valve is closed; when solenoid is energized the valve opens instantly to full capacity. There is no time lag or delay, and no wire drawing of valve or seat that often results when valves open and close slowly. The manufacturer states that its dependable, trouble-free operation has been proved in test installations which have been in service for as long as 3 years.

Some of the uses of the valve in industrial plants include control of make-up water for boiler feeding, water cooling lines to air and ammonia compressors and to plastic moulding presses. On steam lines it can be used with temperature controlled steam water heaters, heat exchangers and similar equipment. It can also be used to control the supply of steam to processing, plating and cooking equipment of various kinds, and for remote thermostatic control in heating systems.

Body of the valve is of cast iron or bronze, tested for 150 lb pressure, with top cap and bottom section bolted to body. Valve, seat and valve stem are all of stainless steel.

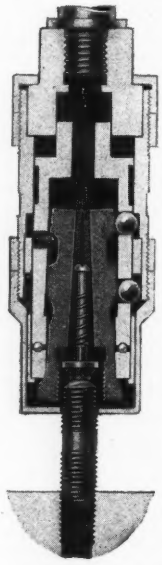
Q Diaphragm Operated Control Valves The Hammel-Dahl Co. offers a full line of diaphragm operated control valves for flow diversion service. These valves are of the three-way type and the position of the diaphragm operated valve plug determines the diversion of flow between the two outlet ports from 0-100 per cent flow. They are available in sizes ½ in. to 6 in., inclusive, in cast iron, steel, bronze, or in stainless steels available in cast form.



The valves feature the company's usual construction of through-bolted bonnet and blind-headed flanges, all steel diaphragm superstructure, valve position indicator, two-ply Neoprene diaphragm, grease lubricator for stuffing box, bolted stuffing box gland. They are suitable for operation with standard 2-15 lb. air output controllers or for controllers requiring special spring rangers. For high temperature service, airfin bonnets are available. The face-to-face dimensions are in accord with ASA standards as covered by B16.10-1939 Face-to-Face Dimensions of Ferrous Flanged and Welding End Valves.

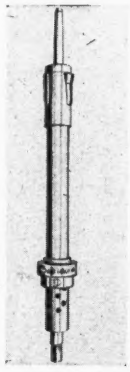
R Self-Opening Stud Driver. This product incorporates automatic take-up for wear on jaws; affords accurate maintenance of projection heights. This stud driver operates at any speed desired and is made in four sizes: For 3/16, ¼, and 5/16 in. studs; for 5/16, ⅜, and ½-in. studs; for ½, 9/16, and ⅝-in. studs; and for ¾, ⅞, and 1-in. studs. Clutch on the driver can be renewed inexpensively by pressing the cam ring out of the main ring, reversing it, and pressing it back in, thus obtaining double wear. A low-priced repair kit is available for this operation. After both sides of the cam ring are worn, a new one may be purchased at low cost.

For applications where it is desired to limit the amount of torque applied to the stud during driving, a special controlled stud driver is available. This tool has an adjustable overrunning clutch so that stud can be driven to any predetermined torque. Both types are exceptionally accurate in maintaining projection heights. Titan Tool Co.



Left, Stud Driver

Below, Tube Expander

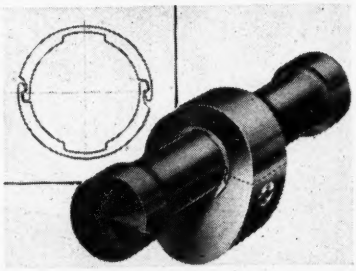


S Special Purpose Tube Expander This new Special Arch Tube Expander, by Richard Dudgeon, Inc., is designed especially to permit fast economical repairs where the boiler construction makes the tube inaccessible for ordinary retubing methods. The special tool eliminates climbing into the fire box to reach the inside ends of the lower pass tubes. It avoids dismantling the outer boiler jacket or cutting through this jacket with an acetylene torch to gain access to all of the tubes.

Designed to roll the far ends of tubes into the tube sheets in installations where no provision is made to gain entry for readily rolling the tubes. The expander enters from the smoke box, or fire door, and reaches through the whole length of the tube to roll the far end. A revolving stop collar on the frame extension permits adjustment of the expander for various lengths of tubes. Tapered rollers provide parallel expansion.

The expander is manufactured with a solid frame shank as shown, or in two parts joined by a quick-acting coupling. The mandrel is also furnished solid or in two parts. The split design is particularly adaptable where the boiler is placed so close to the wall that there is just sufficient clearance to replace the tubes, and not enough space to insert a one piece expander. The expander frame and front section of the shank are first inserted in the tube. The second frame section is then quickly joined to it. The mandrel is inserted in the same fashion.

T Retaining Ring Among the war born developments in retaining rings now available, is a new ring of two-part interlocking construction made by Waldes Kohinoor, Inc. Fitted over a shaft

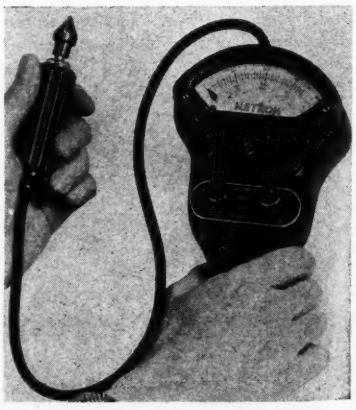


in a radial direction, the ring forms a complete annular shoulder of uniform section height around the circumference of the shaft. This feature substantially increases the normal thrust capacity of the ring.

Consisting of two mating halves that interlock, the ring is of dynamically balanced design and therefore particularly suitable for equipment involving high rates of rpm such as spindle speeds of textile machinery. Because of its positive interlocking action, the ring cannot be lifted out of its groove by high centrifugal forces or by linear expansion caused by friction with abutting parts or surfaces. Yet, disassembly of the ring requires nothing more than a slight prying action with a screw driver.

U Low Speed Tachometer Now available for direct measurement of speeds down to 10 rpm and 1 fpm is the new metron low speed hand tachometer type 25B which has 3 ranges of 10 to 200 rpm, 20 to 400 rpm, and 50 to 1,000 rpm. This instrument is similar in appearance to the standard type 25A which has ranges of 10 times the above values but is inherently sensitive to low speeds and does not employ gears or require the use of speed reducing adapters to measure these speeds. The instrument is particularly useful in the textile, food and metal processing industries where it is desirable to get a continuous indication of low rotational or linear speeds.

This tachometer consists of two units, namely, the head which is normally held in the left hand when making measurements, and the indicating unit which is normally held in the right hand when making measurements. This arrangement is



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STEAM ENGINE

IT SURE IS Adaptable!

An offhand check of the sales of Troy-Engberg Steam Engines shows quite a variety of equipment being driven. For example:

exhausters
pumps
draft fans
blowers
mixers
conveyors
generators
cookers
dryers
line shafts
air compressors
refrigeration compressors
ventilating fans

Probably *economy* and *dependability* provided the first two reasons why the steam engine was selected. Other reasons, however, were influencing factors: flexibility, close speed control, high starting torque; ability to carry heavy overloads for long periods, and in the case of some process plants, explosion-proof design.

The first two reasons—economy and dependability—should interest you in connection with that drive you are planning to buy.

Interesting information on the Troy-Engberg Steam Engine is given in our Bulletin 306. Send for a copy.

TROY ENGINE & MACHINE COMPANY

Established 1870

893 Railroad Avenue • Troy, Pennsylvania

TROY-ENGBERG

STEAM ENGINES • GENERATING SETS • GENERATORS

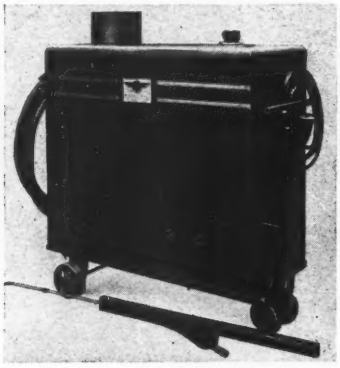
very convenient when measuring speeds of rotating shafts which are in inaccessible places such as under benches, etc. Finger tip control is provided on the indicating unit so that the speed range can be easily changed by the thumb of the right hand while making a measurement. No damage will result to the instrument if the speed range is varied while the tachometer head is engaged with the rotating shaft. Also, the tachometer cannot be damaged by overspeeding. It is announced by Metron Instrument Co.

V Vapor Steam Cleaner

A new vapor steam cleaning machine for cleaning machinery, engines, walls, windows, tanks, and vats and for stripping paint has just been announced by White Engineering & Mfg. Co.

Designated as the White Vapor Steam Cleaner Model MO-46B, the new machine is manufactured either as a stationary unit with base, a movable unit with casters, or as a trailer carried unit.

A feature of the equipment, two easily accessible valves enable one man to operate the machine and pressure, once set, is automatically controlled throughout the



cleaning operation. There are only four valves on the whole machine.

Adjustment of the mixture is made possible by one of these two valves, which permits regulation from full concentration of cleaning compound to clear vapor for rinsing.

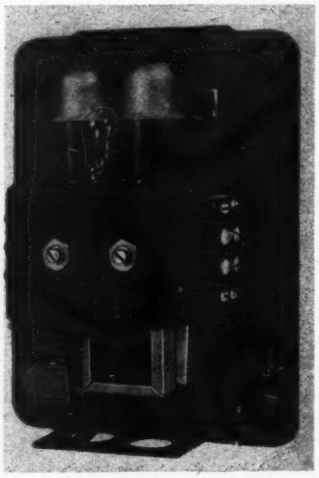
Another feature of the unit is a system of instantaneous electric ignition which enables the working pressure of 100 lb to be rapidly reached, eliminating waiting for unit to warm up or any need for pre-heating. Operating pressures 75-125 psi. Normal pressure is 100 lb. Maker states these are true nozzle pressures.

Special sootless down-draft burner and extra flame travel allows perfect combustion completely eliminating deposits of unburned fuel on the heating coils. Heating coil design permits easy removal of individual coils. Coil arrangement provides maximum heating efficiency. The units burn No. 1 fuel oil, kerosene or light oil.

W Temperature Control Unit

The new Xactline temperature control made by Claude S. Gordon Co. provides unusually close temperature-variation control; variation as low as ⅛ of a deg and power "on-off" cycles as short as three seconds have been attained. The unit accomplishes this without the use of cams, motors, bearings, shafts, gears or other rotating mechanical parts. It is factory-tested for immediate operation and gives "straight line" temperature control without complicated coordination with other equipment.

According to the manufacturer, Xactline is a solution for costly overshoot and undershoot temperature variations prevalent in the plastic, molding, tempering, alumi-



num heat treating and other heat processing fields.

It is inexpensive and can be used on all types of electrical furnaces, ovens, etc. employing conventional millivoltmeter and potentiometer type controlling pyrometers or gas-fired equipment employing solenoid-controlled or motor operated valves. It is housed in a cast aluminum case 8¼ in. high by 6¼ in wide and 3 in deep, and designed for surface mounting installation.

X Reed Vibrometer

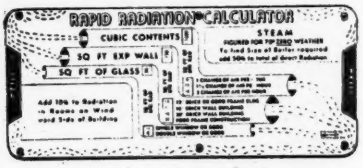
The Davey Reed Vibrometer is an instrument of vest pocket size, weighing only 5 oz., for accurately measuring machine vibration and comparing amplitudes. Its range is from 450 to 50,000 cycles per minute. It operates on the tuned reed principle. A steel reed is fed out from the body of the instrument and when the reed comes into tune with the machine vibrations it will snap into sharp vibration. A machine vibration of 0.001 in. will produce a reed vbration of approximately one half inch. Vibration frequency in cycles per minute is read directly from a graduated dial. In cases where there are several disturbing frequencies or vibrations are of complex wave form, the instrument will pick out each of the frequencies separately and evaluate its comparative amplitude. The upper end of the scale is valuable for noise analysis. When the reed is plucked it will produce a musical note and if it is tuned to correspond to the noise emanating from the machine, the noise frequency may

be determined. There are cases in which this simple instrument can replace a complex noise analyzer. It is manufactured by The Vibroscope Co.

In operation, the pressures in the two chambers are usually maintained at the same value, so that there is no gas flow through the throat section. Zero gas flow, or a flow in either direction, can be maintained by automatic control of a damper in the exit stack of the upper chamber.

Y Radiation Calculator

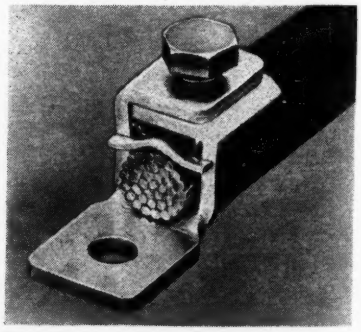
A new, accurate, Rapid Radiation Calculator has just been perfected by the Smithson Co. It is the only simplified sliding scale of its kind and should prove to be of inestimable value to oil burner service men and salesmen, engineers, plumbers and steamfitters. For it saves laborious calculations and insures greater accuracy in determining the heat requirements of any room or rooms.



This calculator quickly and reliably shows the amount of steam, hot water and warm air radiation required for rooms, houses and buildings of various types of construction. It eliminates errors usually found in ordinary time-consuming methods of calculating heat losses. Made of Vinylite (an exceptionally durable plastic), pocket size 7 in x 3 in., printed in three colors. Simple to understand and use, and based on engineering standards of Btu heating losses.

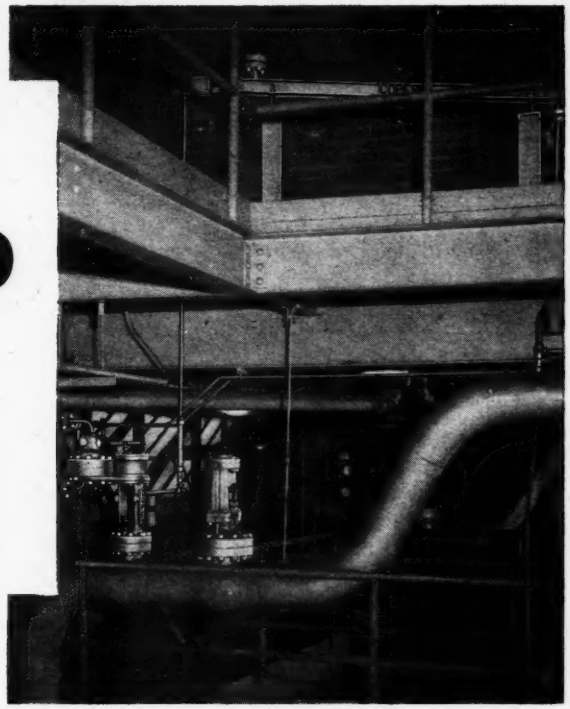
Z Solderless Lug

A new large size Scrulug has been added to this family of low-cost solderless lugs. It is announced by Burndy Engineering Co., Inc. This new size, the KPA34, accommodates a range of wire and cable sizes from



No. 4/0 wire to 500 Mcm cable. The Scrulug is quickly installed by simply tightening the clamping bolt which forces a pressure bar upon the cable. In spite of the fact that a large range of wires and cables will be accommodated, it was designed to have the operating characteristics of the largest cable. Formed from pure-copper and brazed for added mechanical strength, the conductivity, pullout value, and the performance greatly exceed the Underwriters' Laboratories Inc. requirements. It is reported by the manufacturer that these connectors are stocked in their many distribution points.

BOILER LEVEL HELD ±1/2 inch AT EASTERN UTILITY



WITH no pressure control on the constant-speed, motor-driven centrifugal boiler feed pumps, water level is held within plus-or-minus one-half inch in this 675-psi Erie City boiler in service at an Eastern utility plant. Load changes, over a range from 65,000 to 150,000 pounds of steam per hour, mean marked changes in differential water pressure, but the COPES Flowmatic Regulator *automatically* compensates for such pressure variations.

The COPES Flowmatic is a two-element control, responsive to rate of steam flow and to changes in boiler water level. It is recommended for boilers subject to rapid or wide fluctuations in demands for steam. Direct- or relay-operated, depending on the service conditions, it may also be provided with remote control by air, permitting the control valve to be installed at any desired location with respect to the steam-flow and water-level elements. Independent of all other controls and auxiliaries, it is as *dependable* as the single-element COPES, which has been setting performance standards for more than 33 years. The COPES Flowmatic has now been ordered for more than 1700 plants.

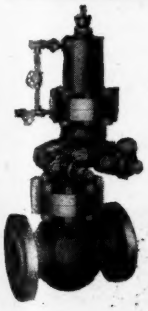
Performance Report, Bulletin 445, tells fully the story of this utility installation of COPES Flowmatic. Illustrated with a sectional drawing of the boiler and charts showing steam flow, feed flow and water level under typical conditions, it should be in your reference file. Write for it.

NORTHERN EQUIPMENT COMPANY
1162 GROVE DRIVE, ERIE 6, PENNSYLVANIA

Feed Water Regulators, Pump Governors, Differential Valves, Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS: Canada, England, France. Representatives Everywhere

★GET CLOSER LEVEL CONTROL WITH COPES FLOWMATIC

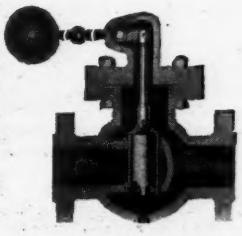


PUMP GOVERNORS

In most installations, especially where the load conditions do not warrant COPES Flowmatic control, good feed water regulation should begin at the boiler feed pumps. *Dependable* excess water pressure control for your feed system, no matter how simple or how demanding your needs, can be provided by COPES engineers. Write—outlining your operating conditions in detail—for their helpful recommendations.

BALANCED VALVES

Many plants have found real savings by paying a few dollars more for COPES Balanced Valves for controlling make-up water to feed water heaters, level in open tanks, evaporator flows and other uses. Control is more accurate with the scientifically-balanced, practically-frictionless COPES. Operation continues satisfactory over a longer service life because of rugged construction. Write for data.



Tops FOR TOP PRESSURES

On steam lines where pressures go as high as 1500 psi, and temperatures up to 900° F. are encountered, steam traps must be rugged . . . and *efficient!*

That's why so many public utilities and other high pressure steam plants are installing Yarway Integral Strainer Impulse Steam Traps. First cousin to the famous standard Yarway Impulse Steam Trap, the integral strainer trap has been developed especially to meet high pressure trapping requirements.

It has ample condensate capacity when system is being "warmed up." Yet it will handle relatively small amounts of condensate efficiently without losing prime. The valve closes positively in the presence of dry or superheated steam.

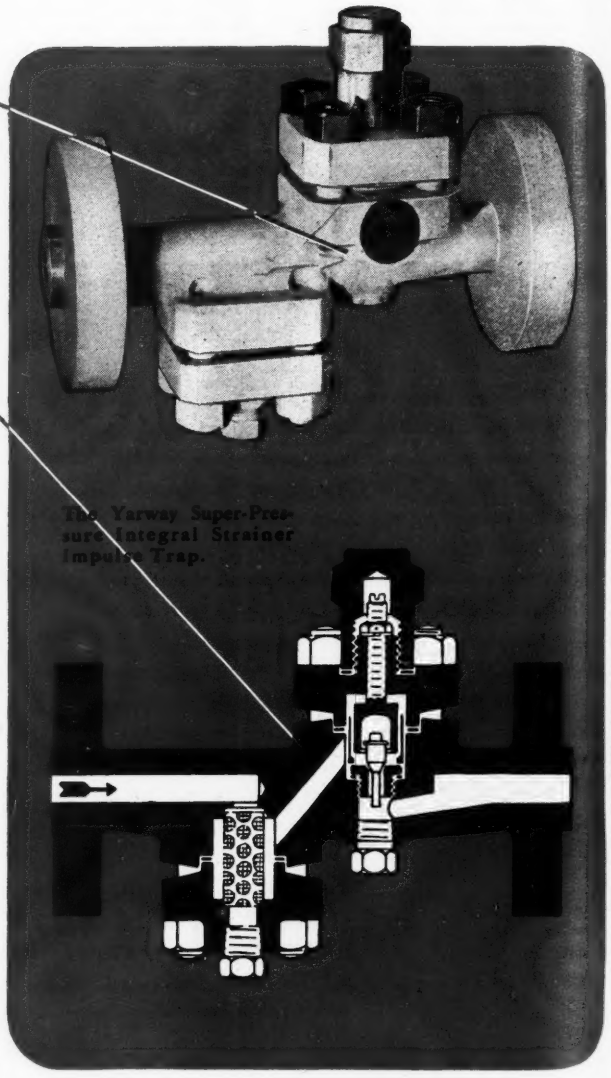
It is a fraction of the size and weight of other type traps designed for the same service—saving space simplifying installation and requiring no supports.

It is suitable for all pressures within a wide range without change of valve or seat.

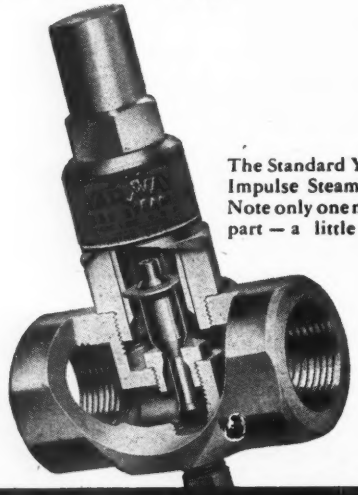
It has the same simplicity of design as does the standard Impulse Trap shown below—only one moving part, the same little valve.

Its integral strainer protects trap against scale and rust in the piping system.

Available with flanged or socket weld connections. Write for Bulletin T-1739.



The Yarway Super-Pressure Integral Strainer Impulse Trap.



The Standard Yarway Impulse Steam Trap. Note only one moving part — a little valve.

See these traps and other Yarway steam plant equipment . . . hear their operation described by Lowell Thomas in the Yarway color motion picture, "There Is An Engineering Reason." Available without charge for group showings. Write today.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY—

Leadership by Persuasion

By DAVID C. PRINCE

THE PROBLEM of leadership may be divided into three parts: (1) The will to lead toward a goal: (2) the know-how required to proceed in the direction of the goal; and (3) the knowledge of how to obtain a following.

Almost by definition a leader must wish to lead somewhere. He must have the vision that his goal can be attained and that it is worth a struggle.

The Road to Leadership

Since we cannot know that any given goal is impossible of attainment, we must reorient our thinking to see what goals are worth a struggle. Hence in the process of training for leadership, the trainee should probably be started on his way by being assigned goals relatively easy of achievement. The neophyte in leadership should have his confidence built up by being assigned problems in leadership, beginning very simply where success is sure and then proceeding to more and more difficult cases.

The leader must likewise be developed to a point where he is not discouraged by his inability to solve an important problem but will continue to try and try again as long as he believes the solution of the problem to be really worth the effort.

Little time need be devoted here to the matter of know-how, i.e., the ways and means whereby the goal may be reached. Our whole technical educational system is devoted to teaching know-how. It is on account of our know-how that world leadership is being forced upon us; and there is very little doubt in anyone's mind that, in so far as technical know-how is concerned, we shall not fail.

A Leader Must Have A Following

Securing followership, however, may be quite another matter. It is not enough that a leader may have selected a goal worthy of attainment, that he may have confidence that it can be attained, and that he may know the necessary steps to progress toward such a goal. If he cannot secure a following, he is not a leader.

However, securing a following is, in its turn, a technical problem. A great many books have been written on the subject which was so popularized by Dale Carnegie in his "How to Win Friends and Influence People." In fact, the idea may have been oversold. The impression may have been created that it is only necessary to spend a half an hour with a popular book to become a supersalesman. As a matter of fact, most of the books on the subject of persuasion deal effectively with only one or two points; whereas an individual of great persuasive powers must be able to meet a wide variety of situations involving diverse personalities.

Requirements of Leadership

In order to secure a comprehensive coverage in this field it would seem likely that an approach should be made comparable to the approach of a professor writing a college textbook. The textbook endeavors to cover, at least in outline form, an entire field. A comprehensive general approach is still lacking, although enough progress has been made to indicate a comprehensive outline as follows:

Appeals to Reason

Man is differentiated from the lower animals by his ability to reason. Therefore, appeals to his reason are the most basic appeals to a human being.

1 *Benefit to the Other Fellow.* The effort is made to draw a distinction between qualities inherent in the proposal itself and the benefits which flow from those qualities to the subject. For instance, a gold coin is of no value whatsoever unless there are goods or services available to buy with that gold coin.

2 *Good Qualities of Proposal.* Good qualities are those properties inherent in the proposal which provide logical reasons why the subject may expect to enjoy the benefits offered. Thus in clothing, high-quality material provides benefits in the form of handsome appearance, long wear, etc.

3 *Loss to the Other Fellow.* Most of our actions are motivated by the hope of reward and also by the fear of punishment. The benefits of item 1 constitute rewards. The losses of item 3 constitute the punishments likely to result from a failure of the prospect to agree with the proposed action.

4 *Poor Qualities of Other Proposals.* Just as there must be good qualities furnishing reasons why, if one is to expect a benefit, so there must be poor qualities furnishing reasons why, if one must expect a loss.

5 *Prestige (Others Are Benefiting) Precedent.* Most of our experience is based on trial and error. However, we early learn that many of the errors can be avoided if someone else has made the trial and found it to be a success. Therefore one of the strongest appeals to reason on any course of action is to show that others have taken the same action and that the results have been good.

6 *Story (How Others Benefit).* If the desired action contemplates a succession of steps, the logical sequence can best be developed in the form of a story which recites the various steps to be taken in their proper order and ends up with the benefits obtained.

7 *Explanation (Tell How).* In our present mechanical age it goes without saying that any procedure beyond the most elementary requires an explanation.

8 *Demonstration (Show How).* Where possible, the best appeal to reason is an actual demonstration of the procedure proving conclusively that the benefits do, as a matter of fact, flow from the good qualities of the proposal.

Items 1 and 8 can be amplified with different examples for every different situation.

Appeals to Emotion

Appeals to emotion might seem unnecessary among highly intelligent and educated people. However, if we are to be honest with ourselves, we must recognize that none of us is entirely free from emotional appeals. Appeals for charity are almost entirely emotional. The entire amusement industry is of course, built on emotional appeal and nothing else. Even in our day-to-day contacts regarding matters which would appear to be entirely within the realm of reason, emotions also play a part.

9 *Manners (Yours Affect the Other Fellow).* Anyone of us will do what he thinks is the right thing with greater alacrity if the manners of those who

(*Continued on page 111*)

Many people, on many recent occasions, have discussed the vital necessity of training engineers for leadership. Few of them, however, have taken the trouble to think out what leadership is and how a leader must function to get it. But Mr. Prince has taken the trouble. And we have seen few analyses so comprehensive yet practical as this one, presented before the 1945 Annual Meeting of the ASME last November and subsequently published in Mechanical Engineering. That is the reason we present extracts from it so soon after his other interesting paper, "Are We Winning the Peace?" abstracted in our July, 1946 issue. Mr. Prince, as you recall, is vice-president of General Electric Co. in charge of the General Engineering and Consulting Laboratory at Schenectady, N. Y. For full information about him, see page 69, July issue

Dependable Steam and Power for Lee of Conshohocken

By F. LEOPOLD Chief Engineer, Lee Rubber & Tire Corporation, Conshohocken, Pa.

As told to CHESTER R. EARLE, Associate Editor, *Power Plant Engineering*

AS THE FIRST STEP in a program for modernizing the steam and power service facilities for Lee Rubber & Tire Corp. at Conshohocken, Pa., about 15 miles up the Schuylkill River from Philadelphia, a new steam generating plant, Fig. 1, has been built and has been in operation since October, 1945. The second step will be the installation of a non-condensing steam turbine generator unit to supply exhaust steam and electric power to the processes. This second step will be carried out as soon as the unit can be supplied by its manufacturer.

In designing these new facilities, the highest degree of reliability was the primary consideration. The former boiler plant, containing six 275-hp straight-tube header-type water-tube boilers fired with coal burned on overfeed stokers, was obsolete. The boilers had been taxed to the utmost in carrying the war load, their operating pressure had already been progressively reduced over the years to the present value of 140-psi and their capacity had always been limited by low boiler settings. All electric power was purchased and, on various ocacsions, severe thunderstorms, occurring frequently in this particular valley and naturally beyond the utility's control, have interrupted electricity supply and caused costly shut-downs. Considering the expected increased output of the Lee plant to meet the post-war civilian requirements, it was clear that new power facilities were needed if reliability of operation and low product costs were to be maintained.

Basis of Design

Steam would have to be generated in any case, since it could not be purchased, and the old boilers were not suitable for remodeling. The process steam and electric power load was such that generation of all needed electricity at the plant would require some combination of condensing and back-pressure or extraction units. However, a good supply of condenser circulating water was not available at low cost, because the plant is located on a hillside, well above river level, and river water would have to be pumped at considerable head, while enlargement of the existing plant water supply system to provide condenser circulating water would be too expensive.

Accordingly, it was decided to install a completely new steam generating plant, with a back-pressure turbine generator supplying all the required process steam from its exhaust, furnishing as much electric power as could be generated from this amount of steam; and to buy any needed additional electric power. Furthermore, to secure the needed reliability, this plant should have sufficient steam-driven auxiliaries to be independent of any outside power source, and thus able to supply service to vital continuous processes even if outside power is interrupted. Pulverized-coal firing was selected because it offered great flexibility in burning a wide range of coals if necessary, or easy conversion to oil in an emergency.

Fig. 1. Exterior view of new boiler plant at Lee Rubber & Tire Co. Coal storage silo at left; ash storage silo in foreground next to stack. This new plant has normal continuous steam capacity of 80,000 lb per hr

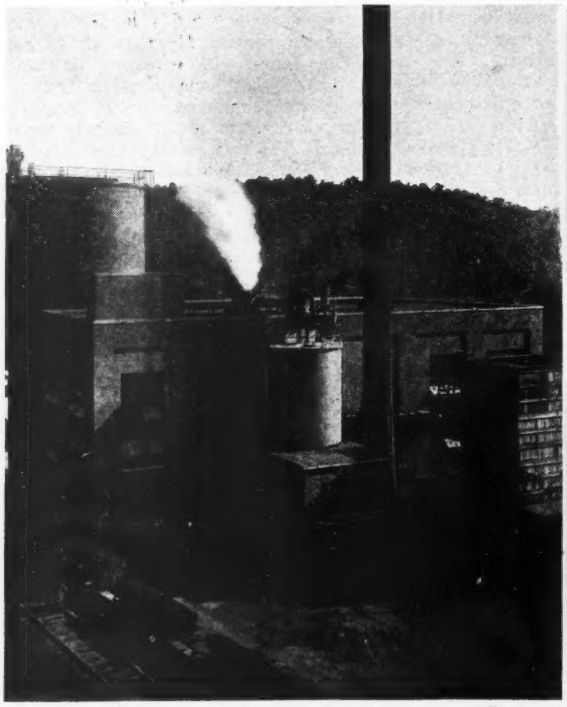
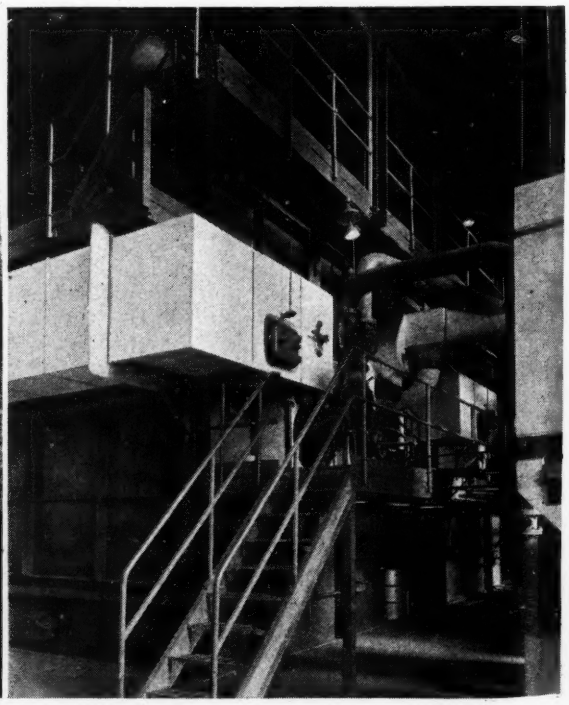


Fig. 2. View in Lee boiler room showing fronts of two 40,000-lb-per-hr, 480-psi, 700-F boilers; pulverizers at right. Note cross-connected burners; each mill can fire both boilers at substantially full load



To modernize obsolescent facilities, Lee Rubber & Tire Corporation of Conshohocken, Penna. builds new 80,000-lb-per-hr, 480-psi boiler plant . . . Future 1875-kw back-pressure turbine generator unit will supply all process steam as exhaust steam at 90-100 psi, generate electric power in proportion to process steam demand . . . Additional needed power will be purchased . . . Two new boilers fired by pulverized coal . . . Dual drive auxiliaries give flexible heat balance . . . Steam-turbine drives on auxiliaries supply 3-psi exhaust steam for feedwater heating and winter building heating, enable plant to supply steam and power to vital continuous processes, prevent costly shutdowns . . . Motor and steam-driven pumps for plant water supply and hydraulic systems . . . House generator for emergency power . . . Many synchronous motor drives in factory maintain unity power factor

The design provides that the back-pressure turbine generator will float on the process steam lines as a power-generating reducing valve, supplying all the process steam at 90 psi from the turbine exhaust as shown in Fig. 3. The maximum process steam requirements are expected to be about 40,000 to 50,000 lb of steam per hr at 90 psi and these can be supplied through an 1875-kva turbine with initial steam conditions of 475 psi, 700 F, exhausting at 90 psi. The plant has an electric motor load of approximately 8000 hp, of which about 5000 hp are in synchronous motor drives. These permit maintenance of unity power factor, for which a credit is obtained from the utility supplying power from the outside. The steam-driven auxiliaries form a source of low-pressure steam for feedwater heating not heretofore available.

The new steam generating units now in operation consist of two Riley boilers of the two-drum type, Fig. 4, each having a normal continuous capacity of 40,000 lb of steam an hour and a 4-hour maximum capacity of 50,000 lb an hour. They are designed to generate steam at 480 psi, 700 F but have been operated at 140 psi since last October, supplying steam to the plant in place of the six old boilers. Since the turbine is not yet installed, no superheaters have been placed in the boilers but they will be installed as soon as required.

The new boilers have completely water-cooled furnaces fired with pulverized coal supplied by two Riley unit pulverizers. Each pulverizer has a capacity of about 3½ tons an hour, which, at the rate of evaporation of 11 lb steam per pound of coal already attained with these units, is sufficient to carry both boilers at a total steam output of 77,000 lb per hr with one pulverizer. To permit this, the pulverizers are cross-connected to two Riley pulverized coal burners in the front wall of each furnace. The burners are equipped with oil guns for emergency firing.

One pulverizer is equipped with dual drive, consisting of a 75-hp Allis-Chalmers motor and a 75-hp Moore steam turbine, the latter taking steam at 480 psi 700 F and exhausting at 3 psi to the feed heating and building heating headers, as shown in Fig. 3. These units drive the pulverizer at 1150 rpm through clutches that can be engaged or disengaged for quick transfer from one drive to the other. The second pulverizer is driven by a 75-hp Allis-Chalmers motor alone.

Combustion air is supplied for each boiler by a Clarage forced draft fan with a maximum capacity of 65,000 cfm at 6.7 in. H_2O. This is driven at constant speed of 1750 rpm by a dual drive consisting of an Allis-Chalmers a-c motor and a Moore steam turbine. Flue gas leaving the boiler passes through a Riley tubular type air preheater, which heats the combustion air from the forced draft fan to 315 F for delivery as primary air to the burner windboxes and to the pulverizers for mill drying of coal and for secondary burner air.

The air preheater reduces the flue gas temperature to 445 F. The flue gas then passes through a Prat-Daniel Aerotec dust collector, from which it is drawn

Fig. 3. Flow diagram of new Lee power plant, showing how turbine generator unit will supply 90-100 psi steam to processes and how turbine-driven boiler auxiliaries furnish steam for feedwater heating, also increase reliability.

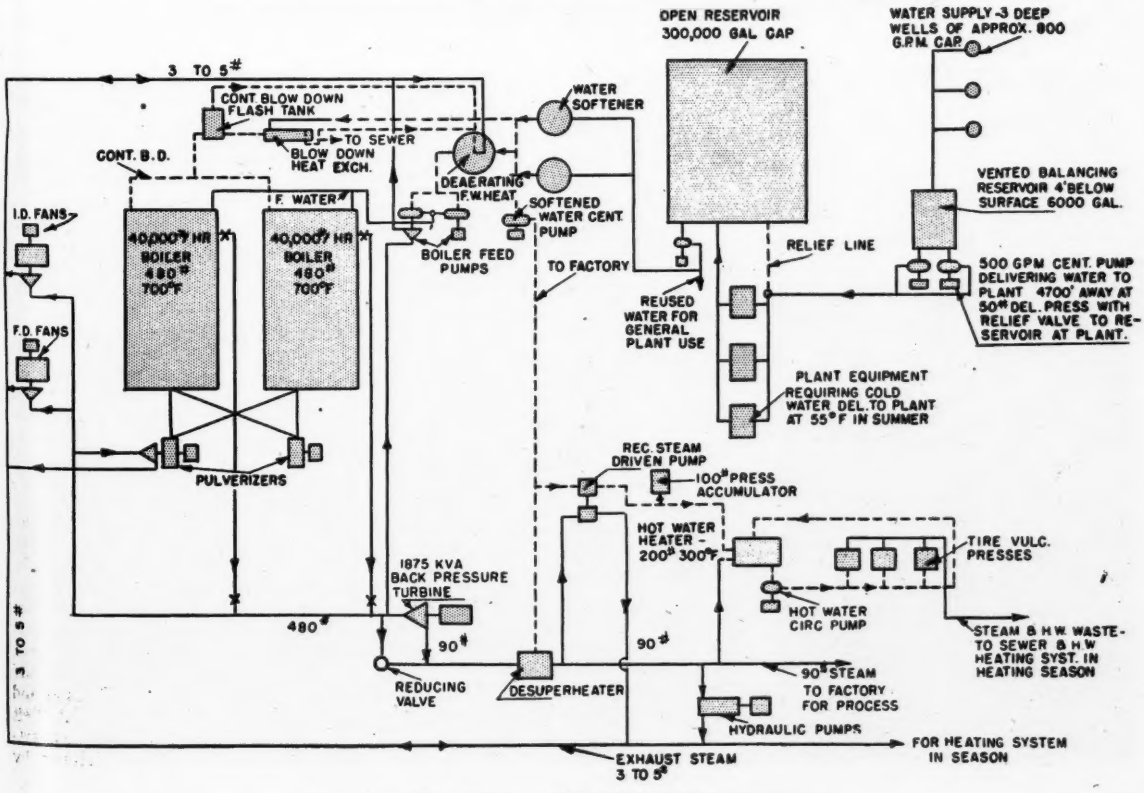
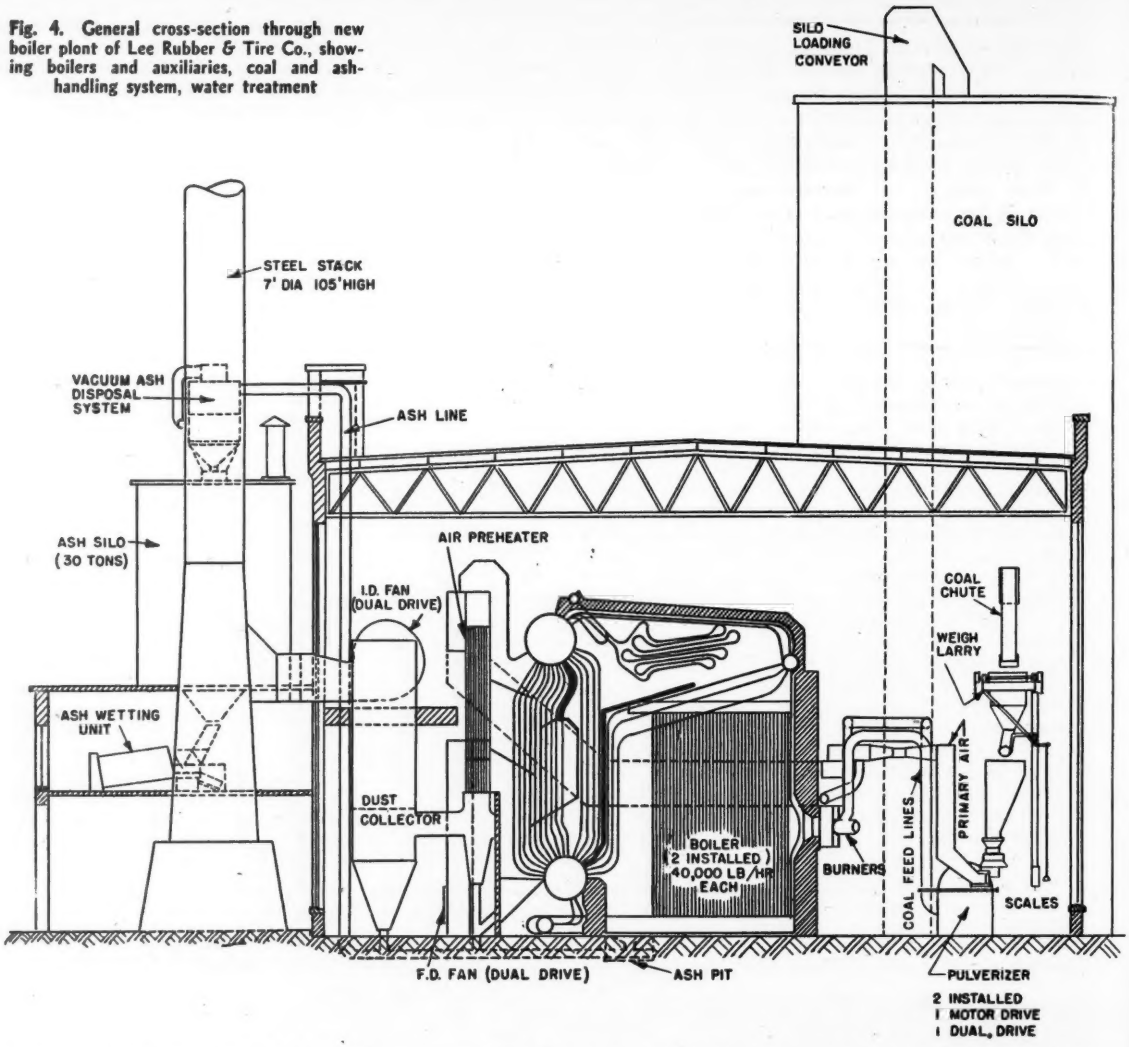

OPEN RESERVOIR
300,000 GAL CAP
WATER SUPPLY-3 DEEP WELLS OF APPROX. 800 G.P.M. CAP.
3 TO 5#
CONT BLOW DOWN FLASH TANK
TO SEWER
BLOW DOWN HEAT EXCH.
CONT. B.D.
WATER SOFTENER
DEAERATING F.W.HEAT
SOFTENED WATER CENT. PUMP
F. WATER
I.D. FANS
40,000# HR BOILER 480# 700°F
40,000# HR BOILER 480# 700°F
BOILER FEED PUMPS
TO FACTORY
VENTED BALANCING RESERVOIR 4' BELOW SURFACE 6000 GAL.
RELIEF LINE
500 GPM CENT. PUMP DELIVERING WATER TO PLANT 4700' AWAY AT 50# DEL. PRESS WITH RELIEF VALVE TO RESERVOIR AT PLANT.
REUSED WATER FOR GENERAL PLANT USE
F.D. FANS
PLANT EQUIPMENT REQUIRING COLD WATER DEL. TO PLANT AT 55°F IN SUMMER
PULVERIZERS
REC. STEAM DRIVEN PUMP
100# PRESS ACCUMULATOR
HOT WATER HEATER - 200# 300°F
TIRE VULC. PRESSES
1875 KVA BACK PRESSURE TURBINE
HOT WATER CIRC PUMP
480#
90#
90#
STEAM & H.W. WASTE-TO SEWER & H.W. HEATING SYST. IN HEATING SEASON
REDUCING VALVE
DESUPERHEATER
90# STEAM TO FACTORY FOR PROCESS
HYDRAULIC PUMPS
FOR HEATING SYSTEM IN SEASON
EXHAUST STEAM 3 TO 5#
3 TO 5#

Fig. 4. General cross-section through new boiler plant of Lee Rubber & Tire Co., showing boilers and auxiliaries, coal and ash-handling system, water treatment

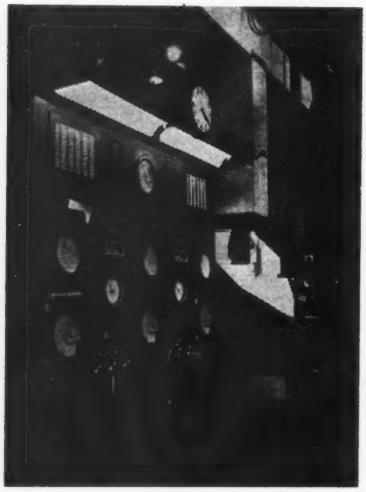


by the induced draft fan and discharged to the steel stack.

Draft Provisions

Each boiler is equipped with a Clarage induced draft fan of 72,000 cfm maximum capacity at 5.6 in. H_2O, also driven at constant speed of 1150 rpm by a dual drive consisting of an Allis-Chalmers a-c motor and a Moore steam turbine. Turbines of both fans are designed to take throttle steam at 480 psi, 700 F and exhaust at 3 psi as in Fig. 3.

Fig. 5. View of boiler control panel for two 40,000-lb-per-hr boilers at Lee plant



Both forced and induced draft fans are operated at constant speed, the air flow and draft being controlled by adjustment of the forced draft fan inlet vanes and the induced draft fan discharge vanes. This may be done manually or automatically by the combustion control system to be described below. The pulverized-coal burners are equipped with low-rating dampers to prevent flare-backs and loss of ignition and improve combustion at low rates of boiler operation.

The above boilers and firing equipment, with boiler supports, breeching and duct work and steel stack, were erected by the boiler manufacturer, Riley Stoker Corp.

The steam generating units were designed to burn a wide range of coals but the coal normally burned is Western Pennsylvania bituminous coal of 14,000 Btu per pound, averaging 30 per cent volatile or better, containing 11 per cent ash and having an ash fusion temperature of 2400 F. For a short time a premium coal of 14,500 Btu, 8 per cent ash, 20 per cent volatile was used but the plant is now back on the specification coal.

Coal and Ash Handling

The coal is delivered in hopper bottom cars on an elevated track between the old boiler house and the new one. A small amount can be stored in an outdoor pile but the normal coal storage is a silo built of tile, Figs. 1 and 4. Coal from the cars is dumped to a track hopper from which a belt conveyor transports it to a 30-ton-per-hr Pennsylvania crusher. From this, the coal discharges to a continuous bucket conveyor which loads it into the silo by means of a short screw conveyor. This silo has a capacity of 700 tons, of which 250 tons is live storage and 450 tons reserve storage. The silo and conveyors were supplied by Link Belt Co. From the live storage compartment of the silo, coal is withdrawn by

a chute to a Link Belt weigh larry, which transports it to the loading hopper over the feeder of each pulverizer on the boiler operating floor, Figs. 4 and 7.

Ash from the furnaces is removed from the plant by a Beaumont-Birch vacuum ash-handling system. To make ash-handling as simple as possible in this relatively small pulverized-coal plant, the boiler furnaces were built with closed sloping bottoms instead of hopper bottoms. In the side of each furnace just above the furnace bottom, is a large clean-out door and beside this, under the boiler-room floor, is the loading hopper of the ash conveyor system as shown in Fig. 4. Ash is hoed up the gently sloping bottom of the furnace into the ash conveyor hopper and discharged about twice a day.

The steam jet conveyor delivers the ash through traps to remove the coarse material, then through a washer and a bag filter, into a 30-ton tile silo, from which it is discharged to trucks for removal from the building.

Feedwater Supply

Feedwater for the new boiler plant is taken from a new general plant supply that was installed a short time ago. This is shown diagrammatically in Fig. 3. The water supply was formerly the Schuylkill River but there were difficulties because of dirt and sewage and high pumping costs. Accordingly, a supply of deep well water was found some distance from the plant. This water is at a temperature of about 55 F in summer and is pumped into the plant by centrifugal pumps and delivered first to process equipment requiring very cold water. After flowing through this process equipment, the raw water flows to an open 300,000-gal reservoir in the yard of the plant. From this reservoir, water is drawn for other plant processes and for boiler feed make-up.

This well water has an initial hardness of about 15 grains per gallon. For boiler feed, it is first softened in a Permutit sodium zeolite water softening unit. This has two softener tanks each having a capacity of 80,000 gal between regenerations. After softening, the water is heated to 230 F in a Permutit deaerating heater of 100,000-lb-per-hr capacity.

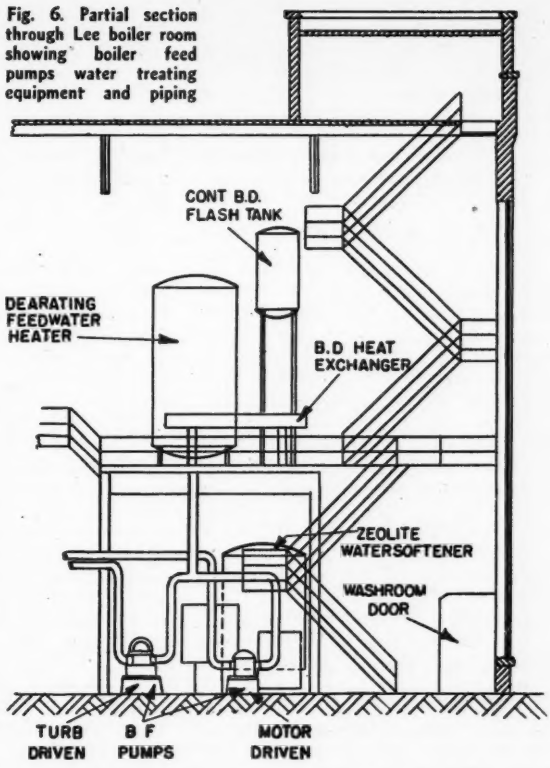


Fig. 6. Partial section through Lee boiler room showing boiler feed pumps water treating equipment and piping

The condensate returns from the factory constitute 15 to 20 per cent of the boiler feed, so that the make-up is between 80 and 85 per cent.

Each boiler is equipped with a continuous blow-down system of 3½ to 4 gpm capacity, with flash tank and heat exchanger, also supplied by Permutit. Phosphate is fed direct to the boiler drums by a Milton Roy chemical pump.

From the feedwater heater, the water is fed to the boilers by two Ingersoll-

Fig. 7. View of one of the 3½-ton-per-hr pulverizers, showing dual drive; weigh larry supplying coal to pulverizer hopper

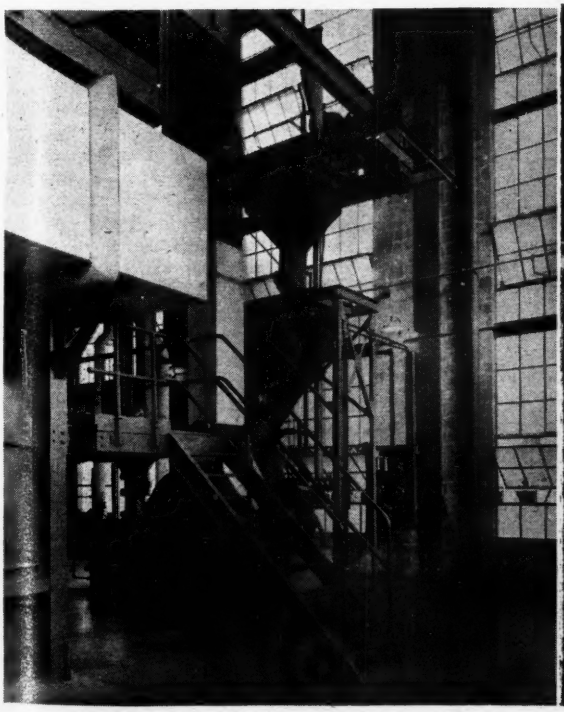
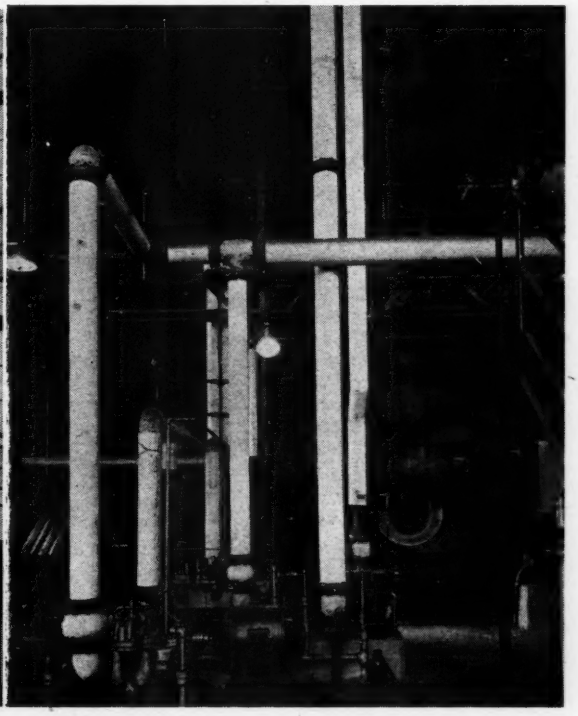


Fig. 8. View of boiler feed pumps and piping looking toward side of boiler. One pump turbine-driven; one motor-driven



Rand (Cameron) centrifugal boiler feed pumps. Each has a capacity of 240 gpm against discharge pressure of 500 psi. One is driven at 3450 rpm by an Allis-Chalmers constant speed a-c motor. The other is driven at 2850 rpm by a Westinghouse steam turbine of 40 hp capacity, designed to take steam at 480 psi, 700 F and exhaust at 3 psi.

How 3-psi Exhaust Heats Feedwater

Figure 3 shows a flow diagram of this plant illustrating how all the turbines driving pulverizers, fans and boiler feed pumps are designed to take 480-psi steam at the throttles and exhaust at 3 psi to the feedwater heating system. This 3-psi system is also connected in winter to the building heating system. By proper selection of drives on pulverizers and fans and the use of either the motor-driven or the turbine-driven feed pump, the required steam for heating can be supplied under all conditions. At present, until the turbine is installed, all steam driven auxiliaries noted above are taking steam at 140 psi.

In addition, a number of Union Steam Pump Co. steam-driven reciprocating pumps supply water for the various process hydraulic systems at 180 psi, 500 psi, 1200 psi and 1900 psi. These pumps all take steam at 100 to 140 psi and exhaust to the 3-psi system, thus helping to balance the steam supply for feedwater and building heating.

Compressed air for the factory is supplied by various motor-driven and steam-driven reciprocating air compressors, which also aid in heat balance adjustment.

Boiler Controls and Instruments

Boiler controls and instrumentation for the above boiler plant are centralized on a control panel on the boiler room operating floor, adjacent to the two pulverizing mills, as shown in Fig. 5.

The boilers are under automatic control of a Brooke automatic combustion control system. In this system, a steam-pressure-actuated regulator governs the coal supply to the pulverizer, by adjusting the feeder knife position, to maintain constant steam header pressure. Boiler air flow is controlled, in proportion to coal feed, by an electronic device. The coal feed regulator is equipped with a potentiometer known as the sender. Attached to and driven by the air control unit is a similar potentiometer known as the receiver. Both potentiometers are connected across the 110-v a-c lines. The sweeps of both potentiometers are connected to the outside leads of a split-primary audio transformer.

Movement of the sending sweep in either direction will cause an unbalance in the transformer primary, with resultant voltages in the transformer secondary in proportion to and in the direction of the sweep movement. These induced secondary voltages are put through one stage of amplification by a 6SN7 tube and an additional audio transformer. The secondary output of this second transformer is connected directly across the grids of two FG-57 Thyratron tubes. The plate outputs of these two tubes are connected respectively to forward and reverse windings of the motor of the forced draft control unit.

Thus, any unbalance created by the fuel control moving the sweep of the sender will operate the motor on the forced draft air control unit until the receiving potentiometer moves a like amount and restores the balance. The air control unit is connected to operate the forced draft fan outlet vanes, the operation of which is thus co-ordinated with the fuel feed to give desired fuel-air ratio.

To adjust the fuel-air ratio to maintain good combustion, a variable resistor (marked "CO_2 raise and lower") is mounted on the control panel and connected in series with the receiving potentiometer. To maintain correct furnace draft, the control unit operating the induced draft fan discharge vanes is actuated solely from furnace pressure.

On the control panel are also mounted a Reliance Eye-Hye Water level indicator, a Ranarex CO_2 recorder and a Ring Balance Instrument Co. steam flow meter and boiler feedwater flow meter for each boiler. An Ellison multi-pointer draft gage for each boiler also is mounted on the panel, indicating furnace draft, forced draft air pressure, induced draft fan inlet pressure, air heater gas outlet pressure and stack draft. Boiler water level is controlled by Copes regulators.

The old boiler plant containing the six 275-hp boilers that are being replaced, will be held for emergency standby service until November, 1946 and will then be torn down.

Power Generation

When the 1875-kva back-pressure steam turbine generator is available, it will be installed in a space in one end of the factory now housing well-water supply pumps and motor-generator sets supplying direct current for variable speed mill drives. New switching equipment will be installed, including automatic throw-over devices to switch vital production equipment circuits onto the turbine generator and keep production going in case outside power is interrupted.

At present a 10-kva generator is operated, to which boiler house and vital factory lighting is switched automatically in emergency. This generator is installed beside one of the pulverizers in the boiler house and is driven by belt from the pulverizer shaft.

Operating Results

Operating results already obtained with the new boiler house during its first nine months of operation indicate that it will give the performance expected. With the present coal, boiler efficiency averages 82 per cent, although with poorer grades of coal it has gone as low as 78 per cent. However, the ability to use all coals economically is a great advantage over the old boiler house. There is naturally a great reduction in maintenance. Minor troubles have been solved very satisfactorily; for example, moisture condensation in the coal storage silo has been completely eliminated simply by building a ventilator over the conveyor at the top of the silo.

Labor has been reduced from 16 men in the old boiler house to 6 men plus a day assistant for general work in the new boiler house. An interesting human factor here is that these 6 men are now regarded by the rest of the plant as the highly skilled specialists they really are, instead of as so many coal shovelers, as in the old plant. They work with their brains and must know what they are doing and why. In fact, one of the present operators, formerly a fireman in the old boiler house, had been laid up for poor health, but now, able to use his knowledge without physical strain, he is a highly-skilled operator in the new plant.

It was originally calculated that the boiler plant would return its investment by savings in 6 to 8 yr. Steam had to be provided in any case. The turbine generator could be figured separately and is expected to return its investment cost in 2 to 3 yr. The final result is reflected, of course, in the cost of the plant's product—tires.

The new power facilities were designed entirely by the Lee engineering organization, assisted by the various manufacturers of equipment. The work was in charge of F. Leopold, chief engineer and H. H. Rice, master mechanic.

A NEW USE for glycerine is given by W. W. Hamel in U. S. Patent 2,400,304. This describes a method whereby materials ordinarily burned or damaged by heat may be coated with a continuous and air-impervious layer of metal sprayed on in the molten state. The secret of the process lies in the use of glycerine solutions which act as protective liquids that vaporize during the actual spraying without leaving a residue. The method is applicable to paper, wood, plywood, leather, textiles, rubber and also to various plastics, glass and ceramics. Sprayable metals used in the molten state include aluminum, copper, gold, silver, zinc, tin, brass, and even various stainless steels. The metal coatings adhere so firmly that the articles can be subjected to mechanical stresses without danger of separating; and the coatings can be buffed or polished or given other finishing treatments. Such coated articles can also be plated and various decorative effects achieved. Papers coated with a thin layer of aluminum or tin by this process have been suggested for use in packaging food.

Boiler for Springdale's New 80,000-kw Unit

COMPLETE DESCRIPTION of new unit at Springdale Power Station of West Penn Power Co. was given in July 1946 issue, *Power Plant Engineering* and details of new 80,000-kw turbine-generator and auxiliaries in October issue. For details of equipment, see List of Equipment, page 115, July issue.

Steam is supplied to the turbine of this new generating unit by a single radiant-type boiler, shown in Fig. 1, designed for continuous output of 800,000 lb of steam an hour with steam condition of 1325 psi and 925 F at the superheater outlet with 430 F feedwater. Features of the boiler, it is stated, include the largest furnace ever built—effective volume 60,200 cu ft—low heat release—15,400 Btu per cu ft per hr at full load—and low gas velocity.

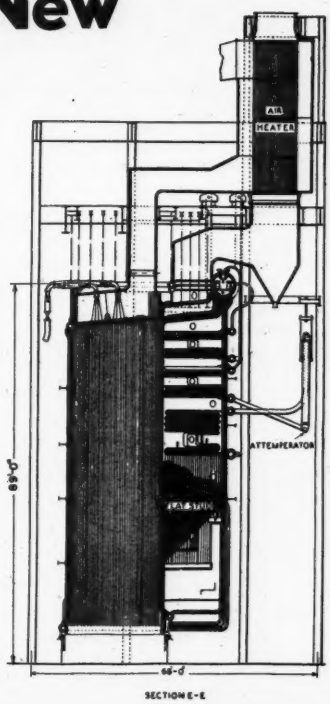
Fig. 1. Right. Cross-section of new Springdale boiler unit—800,000 lb per hr, 1325 psi, 925 F. Entire boiler below air heater suspended from building steel, allowing free expansion in any direction; boiler expands downward 3 in. in starting up. Boiler casing of insulating blocks with plaster finish fastened direct to insulation behind wall tubes, to reduce air leakage and improve appearance. Furnace divided into 2 sections by vertical radiant screen to equalize furnace conditions

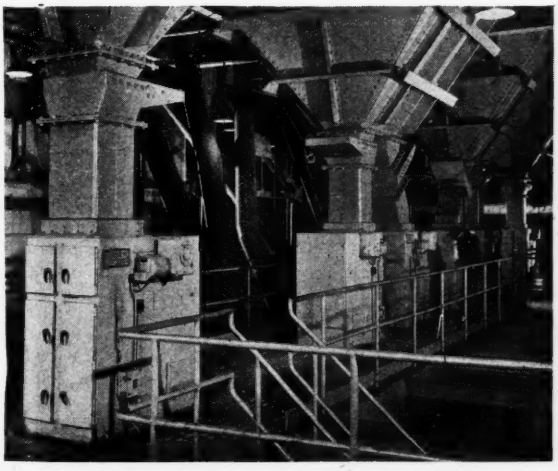
Fig. 2. View of dust-proof automatic recording coal scales, 400-lb capacity each, through which coal flows from bunker through screening hopper on operating floor to pulverizers (See page 112, July issue). To supply additional 1000 tons a day for new unit, changes in coal handling machinery were made. Additional mining equipment, including 300 new type eight-wheel coal cars, two mine locomotives, two mechanical coal loading machines and electrically-operated mine car dump were installed at mine of Allegheny Pittsburgh Coal Co. which supplies coal for Springdale direct through tunnel under Allegheny River

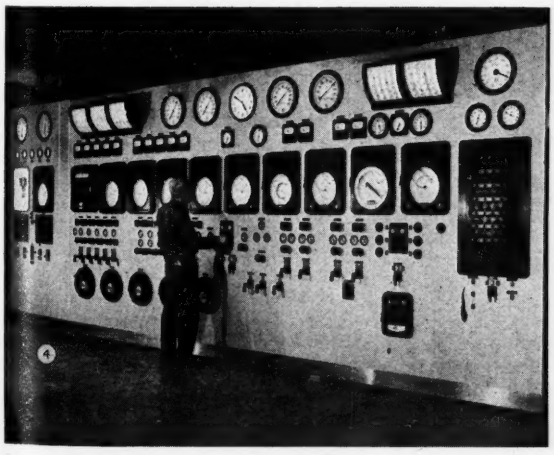
Fig. 3. Five pulverizing mills supply coal for No. 77 Springdale boiler. Row of forged steel balls between rotating bottom grinding ring (driven by cast steel yoke from shaft) and stationary top grinding ring. Pressure on grinding elements adjustable during operation. Mill operates under positive air pressure; automatic coal level control. Designed to produce fineness of 80 per cent through 200 mesh screen and 1 per cent retained on 50 mesh screen at maximum output of 19,300 lb coal per hr; with coal of 60 grindability with total moisture not over 9 per cent

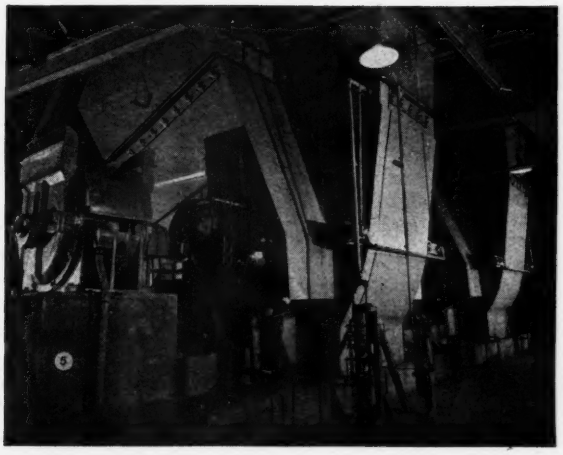
Fig. 4. Instrument and control panel centralizes all controls for Springdale No. 77 at this point. Combustion control operates from steam pressure at turbine inlet; maintains correct mill air temperature, constant furnace draft. Differential master system controls forced draft fan inlet vanes to maintain proper fuel-air ratio

Fig. 5. View of the two induced-draft fans, each vane controlled and driven at constant speed of 695 rpm by 700-hp motor. Each fan rated at 230,000 cfm with flue gas temperature of 425 F, 10.9 in. static pressure. Fans are slow speed to reduce fly-ash wear.









Colorimetric Phosphate Tests for Boiler Waters Containing Tannin

By DR. L. GOLDMAN [1] and DR. R. N. LOVE [2]

WHEN TANNIN is present in a boiler water, it causes certain difficulties in many analytical testing procedures because of its colloidal action in interfering with the removal of suspended matter by filtration and also because of the color it imparts to the boiler water.

For example, in any test for phosphate in boiler water the first step is to filter out of the sample all sludge and suspended solids. Calcium phosphate in the sludge would give high results if not completely removed. If tannin is present in the sample, the sludge and suspended matter tend to pass through the filter paper so that it is difficult to remove it all. It may even be that tannin makes some of the suspended material in the sample completely nonfilterable. If this is true, it would be necessary to destroy or remove the tannin from the sample before filtering to get complete removal of calcium phosphate from the sample. In addition, if the test used is a colorimetric one, the tannin causes interference by its own color.

As the colorimetric phosphate test is so convenient for control purposes and the use of tannin for boiler water treatment has become common, it has become necessary to develop suitable methods for employing the colorimetric phosphate test for boiler waters containing tannin. In this article three different methods for doing this are described and studied.

Groups of typical boiler-water samples containing tannin were tested for phosphate by one of the well-known colorimetric tests, using the following three methods for eliminating the interferences caused by the tannin: (1) potassium nitrate coagulation, (2) potassium persulfate bleach, and (3) tannin removal by decolorizing carbon.

In the first method, the sample is heated with potassium nitrate to coagulate the sludge so that it can be filtered out. Tannin color blanks are used to permit color matching in reading the phosphate concentration. In the second method, the tannin is bleached by heating with potassium persulfate. After filtering, a clear, colorless solution is obtained, which can be tested directly. In the third method, the tannin is removed from the sample by absorbing it with decolorizing carbon, which is then filtered out. This method also gives a clear colorless solution. Some of the boiler-water samples were also tested for phosphate by a more exact gravimetric method.

It was found that the values obtained by the three different methods of adapting the colorimetric tests to boiler waters containing tannin agreed with each other and with values obtained by the gravimetric test closely enough so that any one of the three colorimetric methods can be used for ordinary boiler-water-control purposes. The No. 1 method is the most tedious and time-consuming of the three; the No. 2 method is used when the tannin concentration is very high; and the No. 3 method is the most convenient and rapid for most boiler-water samples.

Colorimetric Phosphate Test

Procedures for making the colorimetric phosphate test when no appreciable tannin is present in the sample are well-known and various test kits especially made for the test are available on the market. In this study, the phosphate color-comparator kit put out by the W. A. Taylor Co., Inc., 7300 York Road, Baltimore, Md., was used.

Directions supplied by the manufacturer for using this equipment can be given in outline as follows: The boiler-water sample is filtered free of all solid material, cooled to room temperature if necessary, and 5 ml placed in a glass tube. This will be referred to as the test solution. Next, 10 ml of a molybdate reagent is added to the test solution. Directions for preparing the reagents are given below. After mixing 2.5 ml of a stannous chloride reagent is added. At this point a blue color is formed in the test solution if phosphate is present in the sample. The depth of blue color formed depends on the concentration of phosphate in the sample.

A color slide is provided in the Taylor test kit, which consists of a series of colored tubes of successively increasing color depths of blue. Each color of the slide gives the color formed in the test solution for a certain definite concentration of phosphate. The concentrations indicated by the color slide range from 5 to 100 ppm; matching the color of the test solution with a color in the slide gives the phosphate concentration. The reading is taken from 1 minute to 5 minutes after the reagents are added.

It was found in this study that phosphate concentrations obtained by matching with the deepest colors of the color slide are less accurate than concentrations obtained by matching with colors in the middle or the low end of the slide. The color brought out in a test solution that has more than 100 ppm of phosphate may appear to match one of the deeper colors of the slide such as the 80 or the 100 ppm.

Therefore if the color obtained in the test solution appears to indicate a concentration of about 70 ppm or more, then, for best accuracy in this test, the filtered sample is diluted with distilled water to reduce the concentration of phosphate in the test solution below 70 ppm. Knowing how much distilled water was added to a certain amount of the filtered sample, the phosphate concentration can be multiplied by the factor necessary to give the phosphate concentration in the original sample. Even when the concentration in the sample corresponds with the more accurate range of the color slide, it is frequently desirable to dilute portions of the filtered sample so as to get readings from two different colors, as a check.

The reagents used in this test for this study were made up as follows:

MOLYBDATE REAGENT—10 grams of reagent-grade 85-per cent molybdic acid are added to 100 ml of distilled water. The mixture is stirred to keep the molybdic acid in suspension, and 47 ml of concentrated reagent grade sulfuric acid (sp gr, 1.84) are slowly added. Stirring is continued until all the molybdic acid is dissolved. After the solution has cooled, enough distilled water is added to make 1 liter of reagent. When correctly prepared, this solution should be approximately 1.7N acid, which is necessary for proper color development.

STANNOUS CHLORIDE REAGENT—120 grams of reagent-grade stannous chloride ($SnCl_2.2H_2O$) are added to 500 ml of concentrated, reagent-grade hydrochloric acid (sp gr, 1.19). The mixture is stirred until all the stannous chloride is dissolved. If necessary, the solution is heated gently to help dissolve the stannous chloride. After the solution is cooled, enough additional hydrochloric acid is added to make up 1 liter of reagent, and it is stored in a dark bottle. This is a concentrated stannous chloride reagent and must be diluted before being used in the colorimetric test by adding 35 ml of distilled water to a 1-ml portion of the concentrated stannous chloride reagent. The diluted reagent formed is unstable and must be made up from the concentrated reagent on the

Reprinted from Bureau of Mines Report of Investigations 3983. Work done under the general direction of J. F. Barkley, Chief, Fuels Utilization Division.

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Presence of tannin in boiler water has required development of suitable colorimetric test methods for determining phosphate content . . . The three methods investigated are: potassium nitrate coagulation, potassium persulfate bleach and tannin removal by decolorizing carbon . . . Potassium nitrate coagulation method is most time consuming . . . Potassium persulfate bleach method described is more convenient because colorless solutions are obtained . . . Decolorizing carbon method found most convenient . . . All three methods described in detail and results compared . . . Detailed results from test samples are tabulated and graphically compared for accuracy

day it is used in making the test.

The depth of blue color developed by colorimetric tests of this general type varies with the amounts and strengths of reagents used. Different procedures would require different color standards.

Where there is appreciable tannin in a boiler-water sample, it is difficult or impossible to filter the sample free of suspended matter. Also, the brown color which the tannin imparts to the test solution gives an off-shade to the blue color formed, so that it is difficult or impossible to get a match by direct comparison with the color slide.

Methods of Adapting the Colorimetric Test to Boiler Waters Containing Tannin

POTASSIUM NITRATE COAGULATION. A quarter teaspoonful of reagent-grade potassium nitrate (approximately 1.5 grams) is added to 50 ml of sample, which is then heated to boiling. This treatment coagulates the sludge so that suspended matter in the sample can be filtered out fairly readily. However, the tannin, as indicated by the color of the sample, is not appreciably removed. The source of heat is removed, and the solution is left undisturbed for a few minutes so that the sludge settles.

The sample is then filtered and enough distilled water added to make up for any loss due to boiling. The sample is cooled to room temperature and the colorimetric test made in the same way as described above under Colorimetric Phosphate Test. The color obtained cannot be matched directly with the color slide because of the tannin color still present in the test solution; however, it is possible to make a match by giving an off-shade color to the colors of the color slide similar to the off-shade color obtained in the test solution.

This is done by the use of brown color blanks which have the same depth of brown as the test solution, but no blue color at all. Such blanks are made by treating portions of the filtered sample in the same way as in the test, with the exception that distilled water is added instead of the stannous chloride so that no blue color is formed. The blanks are placed in line with the colors of the color slide so that the brown of the blanks is added to the blues of the color slide, giving them as much off-shade as is obtained in the test solution.

This makes it possible to match the color obtained in the test solution with the colors of the slide. The reading in this case is taken in about a minute after the reagents are added.

POTASSIUM PERSULFATE BLEACH.[3] Three ml of a 4N sodium carbonate solution are added to a 50-ml sample. An eighth teaspoonful of potassium persulfate (aproximately 1 gram) is then added, and the solution is heated to boiling. The persulfate bleaches the tannin by oxidizing it. The boiling is continued until the tannin color in the sample is all or nearly all removed. For cases of high tannin content, more of the persulfate may be needed. Three more ml of the sodium carbonate solution are added for every additional eighth teaspoonful of persulfate used. The sodium carbonate is added to neutralize sulfuric acid, which is formed from the persulfate during the heating. The solution must be kept alkaline, as acid could dissolve calcium phosphate in the sludge and lead to high results.

After the tannin is bleached, the source of heat is removed, and the solution is left undisturbed for a few minutes so that the sludge settles. It is then filtered and enough distilled water added to make up for the loss from boiling. A clear, colorless, tannin-free solution is obtained. A portion of the filtered solution is tested with phenolphthalein to make sure it is alkaline. If it is not, the test must be repeated, using a little more than 3 ml of sodium carbonate for every eighth teaspoonful of the persulfate. The filtered solution is cooled to room temperature and can then be tested by the colorimetric test. The use of blanks is not necessary. The reading is taken in about a minute after adding the reagents.

TANNIN REMOVAL BY DECOLORIZING CARBON. A number of different grades of decolorizing carbon are available which differ in their capacity to absorb tannin from a boiler water sample and in their effect on the phosphate concentration in a sample. Even in one particular trade-marked grade different batches may have slightly differing properties. Before a particular grade of decolorizing carbon is used for this test, it is necessary to determine whether it has sufficient tannin-absorbing capacity and also whether it removes phosphate from a water to which it is added or if it contains phosphate, which it can add to the water. The grade of decolorizing carbon[4] chosen for this study removes only a negligible amount of phosphate from a sample as determined by testing a prepared solution of known phosphate concentration adjusted to a pH of about 11 to 12 to represent boiler water.

In making the test, two ¼-teaspoon portions of decolorizing carbon (approximately 0.7 gram each) are added, one at a time, to 50 ml of sample in a 125-ml Erlenmeyer flask. The flask is stoppered and shaken vigorously for a half to a full minute after each portion of carbon is added. The sample is then ready for filtering. As it was not boiled in this procedure, there was no loss by evaporation. The filter paper cannot therefore be wetted down with distilled water before filtering, as can be done in the two preceding methods, because this would dilute the sample. The sample is therefore filtered through a dry filter paper. The first portion coming through the filter—about 15 ml—is discarded and the rest taken for testing. It generally is clear and colorless or nearly colorless and can be tested directly by the colorimetric test. The reading is taken between 1 and 5 minutes after the reagents are added.

Where the tannin concentration in a sample is high, this treatment may fail to remove enough tannin to give a nearly colorless solution. In this case, addition of the molybdate reagent may decolorize the test solution sufficiently so that the test can be made. If necessary, the test can be repeated using a little more decolorizing carbon, say three or four ¼-teaspoon portions, in order to get improved tannin color removal. More than this amount should, however, not be used, as in such amounts the carbon can begin to remove measurable phosphate from the sample.[5]

The reason the first portion of sample coming through the filter is discarded is because it was found that this portion contains less phosphate than the rest of the filtered sample. For instance, in one case the first 5 ml of sample coming through the filter contained 30 ppm of phosphate, while successive portions contained 55 ppm. Apparently the dry filter paper removes phosphate from the first portion of the sample as it is filtered.

Comparison of the Three Colorimetric Methods

The potassium nitrate coagulation method is the most time-consuming of the methods, because of the extra time required in preparing the blanks. As the colors which are matched in this test are off-shade blues, this procedure is also frequently considered tedious.

The potassium persulfate bleach method is more convenient because colorless solutions are obtained, eliminating the need for color blanks, even when the tannin concentration is high.

The decolorizing carbon method is the most convenient of all and is best-suited for routine testing of many samples. It is rapid because boiling is not required, and clear solutions giving good color matches are generally obtained. Where

[3] This method, developed by Hall Laboratories, Inc., Pittsburgh, Pa., was suggested to the authors by Dr. R. E. Hall.

[4] Norit A, manufactured by the American Norit Co., Inc., Jacksonville, Fla.

[5] Preliminary studies indicate that the carbon sold under the trade name Norit SG II and manufactured by the American Norit Co. can be used in greater amounts than the Norit A without removing appreciable phosphate from the sample.

the tannin concentration is high in comparison with the phosphate and there is much suspended matter in the sample, this method may fail to give a clear, colorless, or nearly colorless solution. In such cases, the persulfate bleach method can generally be used.

Table I. Results for the group of samples tested by the potassium nitrate coagulation and the potassium persulfate bleach methods

Source of samples	Tannin concentration ppm	Tannin color No.	Phosphate (PO_4) by potassium nitrate coagulation, ppm	Phosphate (PO_4) by potassium persulfate bleach, ppm
California	20	2	45	50
Colorado	8	2	50	55
Florida	50	4	50	60
Do.	20	3	25	30
Illinois	—	3	80	80
Do.	30	3	100	100
Do.	15	3	8	8
Indiana	20	3	110	110
Do.	50	3	55	60
Do.	30	3	90	90
Iowa	40	3	90	100
Kansas	—	3	50	50
Louisiana	8	1	50	55
Maryland	20	3	8	8
Massachusetts	—	3	550	550
Do.	—	3	70	80
Mississippi	60	4	60	70
Do.	50	3	40	40
Do.	125	5	140	140
Missouri	100	5	35	35
Do.	10	2	55	60
New Hampshire	10	3	35	40
Do.	25	4	110	120
New Mexico	30	3	5–	5–
New York	—	5	140	120
North Carolina	10	3	110	120
Ohio	30	3	110	110
Oklahoma	50	3	400	400
Oregon	25	4	55	55
South Dakota	30	3	45	45
Do.	25	2	30	30
Tennessee	10	3	50	55
Texas	50	3	60	60
Do.	25	4	300	300
Do.	30	3	55	55
Virginia	—	4	20	15
Do.	—	3	50	55
Do.	—	3	Trace	Trace
Do.	25	3	350	350
West Virginia	200	5	140	140

Where the tannin concentration in a sample is high and the phosphate concentration is also high, when the filtered sample is diluted to bring the concentration of phosphate into the accurate range of the color slide, the concentration of tannin is lowered at the same time. In such cases, therefore, any of the three colorimetric methods can generally be used. However, where the tannin concentration in a sample is very high in comparison with the phosphate concentration, difficulties may be encountered in the use of any one of the methods. It has frequently been found necessary in such cases to use either the persulfate bleach or the decolorizing carbon method, combined with the use of blanks to balance out the color of any tannin remaining in the test solution, as described in the potassium nitrate coagulation method.

The blue colors obtained in the test solution fade in time. However, when the potassium nitrate coagulation or the potassium persulfate bleach methods are used, the colors fade more rapidly than when the decolorizing carbon method is used. In one case studied, when either of the first two methods was used, the colors started to fade appreciably in about 2 min after the reagents were added. However, when the decolorizing carbon method was used, appreciable fading did not occur during a 5-min period after the reagents were added.

GRAVIMETRIC METHOD. To determine the accuracy obtained by the three methods for adapting the colorimetric test, it was necessary also to have a method which was independent of the colorimetric test and which would be generally accepted as giving accurate values for the concentration of phosphate in boiler water. For this purpose the ASTM Standard Method, Designation D515-43, for determining phosphate in industrial waters was used.

This is a gravimetric method in which the phosphate in the sample is precipitated out and weighed; however, this method was not designed for waters containing much tannin. It was therefore necessary to adjust it for use in testing boiler waters containing appreciable tannin. This was done in the following way: Instead of the procedure given in paragraphs 4 (a) and (b) in the ASTM Standard Method, a definite volume of sample—enough to contain 0.004 to 0.04 gram of total P_2O_5—was taken for analysis. A quantity of phosphate-free reagent grade potassium nitrate, enough to give approximately a 4-per cent solution, was added to the sample. The solution was heated nearly to boiling, and sodium hypochlorite containing 5 per cent available chlorine—about 5 to 10 ml, depending on the amount of tannin in the sample—was added and the solution boiled gently until the tannin color was bleached out by the hypochlorite.[6] The solution was then removed from the source of heat and allowed to stand a few minutes to settle the coagulated material. The solution was filtered and the filter paper washed with 1 per cent potassium nitrate, the wash water being added to the filtered solution. A 15-ml portion of nitric acid reagent was then added in excess of the amount necessary to neutralize the solution, as described in 4 (b) of the ASTM Standard Method. Then 2 to 5 ml of concentrated, reagent-grade nitric acid (sp gr, 1.42) was also added. The acidified solution was heated to boiling and evaporated until the volume was reduced to 100 ml. The analysis was then continued as described in 4 (c), (d), and (e) in the Standard Method. For cases where the phosphate concentration in the sample was small, the ammonium phosphomolybdate precipitate obtained in 4 (c) was weighed directly and was not converted to magnesium ammonium phosphate, as described in 4 (d).

The accuracy of the ASTM Standard Method, as adjusted, was checked in the following way: A group of boiler-water samples which contained phosphate but no tannin were first tested by the ASTM Standard Method. Tannin was then added to the samples, and they were again tested, this time using the ASTM method adjusted as described above. Good agreement between both tests was obtained for every sample tested.

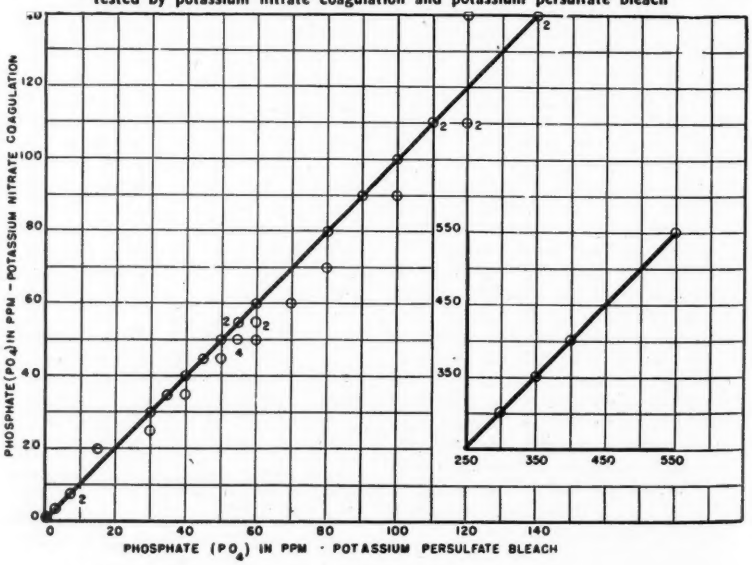
Results of Boiler-Water Tests

HOW SAMPLES WERE TAKEN AND TESTED. The values obtained by the three methods of adapting the colorimetric test were compared by testing a group of boiler water samples taken at random from many Government-operated boilers located all over the country. These boilers are typical, medium-size boilers operated at pressures up to about 200 psi, and all were treated with quebracho tannin. The samples obtained were typical boiler-water samples containing hydroxide ranging in concentration from about 20 ppm up to 200 ppm and having total dissolved solids concentrations ranging from about 1,000 ppm up to 5,000 ppm.

One group of the samples was tested

[6] The use of hypochlorite is not readily applicable to the colorimetric test used, as it can also bleach out the blue color formed.

Fig. 1. Comparison of phosphate concentrations found in a series of boiler water samples tested by potassium nitrate coagulation and potassium persulfate bleach



by the potassium nitrate coagulation and the potassium persulfate bleach methods and another group by the decolorizing carbon and the potassium persulfate bleach methods. To determine the actual accurracy of all three methods, a third group of samples was tested by these methods, and the phosphate concentration was also determined by the adjusted ASTM Standard Method. For this last comparison, the colorimetric tests were made on two separate dilutions for each sample and the results averaged.

Table II. Results for the group tested by the decolorizing carbon and the potassium persulfate bleach methods

Source of samples	Tannin concentration ppm	Tannin color No.	Phosphate (PO_4) by decolorizing carbon, ppm	Phosphate (PO_4) by potassium persulfate bleach, ppm
Alaska	5	2	25	30
Arizona	20	2	10	15
Colorado	15	2	20	20
Florida	25	2	20	25
Idaho	90	4	200	200
Iowa	180	4	40	45
Kansas	10	2	220	220
Louisiana	8	1	50	55
Maryland	5	3	110	110
Minnesota	3	3	50	55
Missouri	75	3	200	220
Do.	25	3	55	55
Montana	2	1	60	60
Nebraska	60	4	50	50
New Jersey	30	3	10	15
New York	20	4	100	90
Oklahoma	15	2	30	35
Oregon	100	5	120	120
Pennsylvania	45	3	200	220
South Dakota	100	3	80	80
Utah	45	2	80	80
Virginia	100	4	110	100
Washington	50	5	280	280
Wyoming	50	4	5–	5–

VALUES OBTAINED. The results for the group of samples tested by the potassium nitrate coagulation and the potassium persulfate bleach methods are listed in Table I and plotted in Fig. 1; the results for the group tested by decolorizing carbon and the potassium persulfate bleach methods are listed in Table II and plotted in Fig. 2; and the results for the group tested by all three methods and the adjusted ASTM Standard Method are listed in Table III. In some cases, one point on the curves represents values obtained from more than one sample. The number is indicated beside the point.

The concentration of tannin in each sample is given in the tables. These values were determined by using the Folin and Denis reagent as applied to analysis of boiler water by Berk and Schroeder.[7]

There is also listed an estimate of the depth of tannin color in each sample by an arbitrary number referred to as the "Tannin color No." of the sample, which is determined by observing the color of a separate portion of the original sample in a test tube. For this step, the portion of sample is first filtered to remove iron rust as much as possible and any suspended matter which might influence or obscure the tannin color. If the filtered portion of sample in the test tube is a very light yellow, the sample is assigned a tannin color number of 1. If it is a dark, nearly opaque brown, the sample is assigned a tannin color number 5. Numbers 2, 3, and 4 indicate increasing intermediate shades of tannin color.

COMPARISONS OF VALUES OBTAINED. Although there are some small differences, the values obtained by the three methods of adapting the colorimetric test all agree closely enough for the purposes of ordinary boiler-water control testing. The samples tested varied widely both in phosphate and tannin concentrations and were obtained from widely scattered sections of the country.

The values obtained therefore show that about the same accuracy can be obtained by using any one of the three methods in testing most boiler-water samples. The values obtained by the adjusted ASTM Standard Method given in Table III show the actual accuracy obtained by the three colorimetric methods. Although the number of samples tested in this way was small, the values obtained indicate that, where the phosphate concentration is not very low, all three colorimetric methods give values which agree closely enough, for control purposes, with an independent gravimetric method.

The general agreement between the potassium nitrate coagulation and the potassium persulfate bleach methods indicates that calcium phosphate is filtered out just as completely when the tannin color is not removed from the sample as it is when the tannin color is first removed. Otherwise, the phosphate concentrations obtained with the potassium persulfate bleach method would be lower than the values obtained by the potassium nitrate coagulation method, in which tannin color remains in the sample.

Laboratory-prepared solutions of phosphate containing tannin and calcium phosphate do not give this agreement between the potassium nitrate coagulation and potassium persulfate bleach methods, as do the boiler-water samples. Specially drawn boiler-water samples tested the same day as drawn give agreement between all three colorimetric methods in the same way as boiler-water samples delivered to the laboratory in the ordinary way involving a delay of a couple of days up to as much as a week.

Table III. Results for the group tested by all three methods and the adjusted ASTM Standard Method

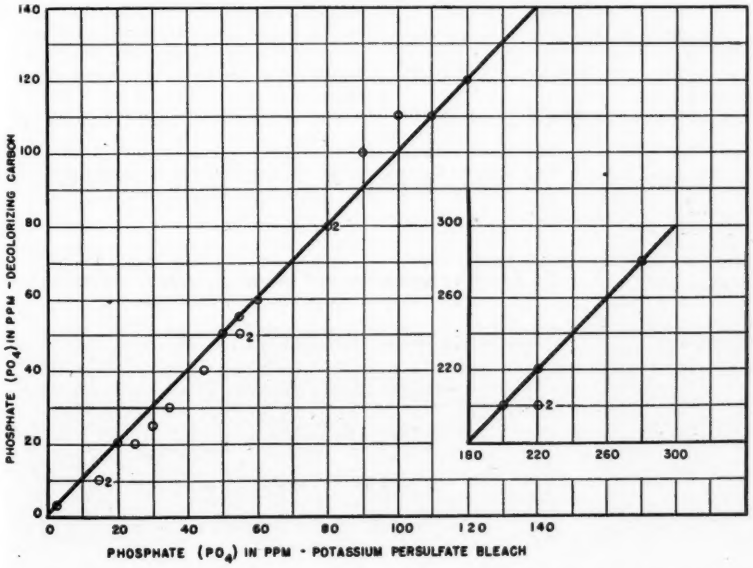
Source of sample	Tannin concentration ppm	Tannin color No.	Phosphate (PO_4) by potassium nitrate coagulation, ppm	Phosphate (PO_4) by potassium persulfate bleach, ppm	Phosphate (PO_4) by decolorizing carbon, ppm	Phosphate (PO_4) by adjusted ASTM Standard Method, ppm
Iowa	50	3	73	77	73	81
So. Dakota	30	3	100	105	100+	104
Texas	200	5	48	58	53	55
Utah	40	3	5+	10	5—	1
Virginia	15	2	77	74	78	78
Washington	25	3	50	57	58	54
West Virginia	10	2	10—	10+	5+	7

Conclusion

The phosphate concentration in boiler waters containing tannin can be determined by a colorimetric method without removing the tannin color. However, the test can be done more conveniently if the tannin color is first removed from the solution either by bleaching with potassium persulfate or by adsorption with decolorizing carbon. A method for using decolorizing carbon in this test has been developed. Of three methods which were studied for doing the colorimetric test, the method using decolorizing carbon is the most convenient and rapid for most boiler-water samples.

[7] Berk, A. A. and Schroeder, W. C., Determination of Tannin Substances in Boiler Water: Ind. Eng. Chem. anal. ed., vol. 14, 1942, pp. 456-459.

Fig. 2. Comparison of phosphate concentrations found in a series of boiler water samples tested by decolorizing carbon and potassium persulfate bleach



Burden Considerations in Application of Transformer Type Instruments

Here is a practical discussion of a subject which is of considerable importance to power plant electrical engineers, in the installation of switchboard instruments. In his work for one of the large electrical manufacturing companies the author found a decided lack of knowledge of the subject among application engineers. This treatment of the subject is new and is of practical value in the application of alternating current switchboard instruments

By PAUL MacGAHAN Consulting Electrical Engineer, Woodstock, N. Y.

ALTERNATING CURRENT instruments intended for power circuits are usually provided with current operating coils wound for five amperes, of voltage coils for 120 v, or both. Such instruments are generally insulated in accordance with the A.S.A. insulation standards, to suit the low potential secondary transformer circuits. When a current or voltage to be measured has a value beyond the operating range of the coils, or when it is necessary to insulate the instruments from the higher voltage power circuits, instrument transformers are employed. The secondaries of these instrument transformers are wound to suit the operating coils of the instruments.

Instrument transformers are designed with accurate and even ratio values. Thus, a potential transformer may for example, be wound for 2400 to 120 v which is a 20/1 ratio, or a current transformer may be wound for 100/5 amp, giving a 20/1 ratio. It is only in special cases that transformers are wound for odd ratios.

The secondary voltage which is impressed upon the operating coil of the instrument is in phase with the primary voltage, and the current which passes through the current coil is in phase with the primary current. The user need not be concerned about the 180 deg relation that exists between the voltages in the primary and the secondary of the transformer he will get his instrument connected correctly independent of this effect.

Reference to Figs. 1 and 2 will illustrate the way polarities are marked on the transformer leads, and in connection diagrams.

All instrument transformers should be grounded on the secondary side. This prevents a static voltage above ground due to transformer capacity, and is a necessary precaution against danger from high voltage resulting from failure of insulation by lightning or other high voltage stresses. Any one point of the secondary may be grounded in polyphase wiring, but preferably at a neutral point or common wire between two or more transformers.

Potential Transformers

The voltage transformer is in principle an ordinary step-down potential transformer designed for close regulation, so that the secondary voltage under any properly applied condition will be as nearly as possible a definite percentage of the primary voltage.

Any error in the ratio of transformation or in phase relation, is due to losses in the transformer, and magnetic leakage.

There are two classes of errors inherent in potential transformers;—ratio error and phase angle error, the latter being the variation from the 180 degree relation between primary and secondary voltages. The part of these errors due to the exciting current is constant for any particular voltage. It is reduced to a minimum by choosing the best quality of iron and working it at a suitable magnetic density. The part of the errors due to load or output current varies directly with the load, and can be minimized by making the resistance and reactance of the windings very low. It is interesting to note that in any transformer, the ratio error can be compensated for, at least in part, by making the actual turn-ratio somewhat different from the nominal voltage ratio.

The effect of phase displacement is negligible when using voltmeters, frequency meters or other instruments operated by voltage only. With wattmeters, watthour meters, etc., however, the readings of which depend as well on the phase angles of the measured load, the phase error has an appreciable effect.

These ratio errors and phase errors are small enough to be generally disregarded for switchboard practice, if and when the instruments and the transformers are properly matched and applied.

The best practice recommends the use

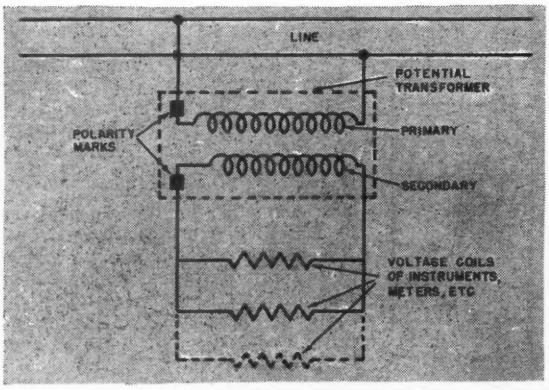
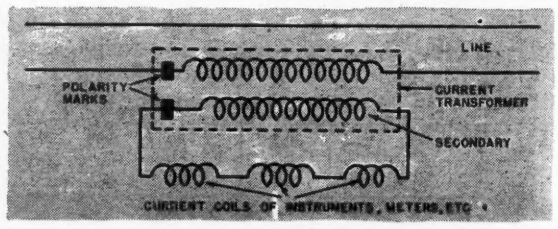


Fig. 1. Left. Connections and polarity markings for potential transformer operating voltage coils of instruments

Fig. 2. Below. Connections and polarity markings for current transformer operating current coils of instruments



of fuses in series with resistors in the primary leads, to protect against short circuits in the primary windings. The resistors are to limit the short circuit currents to about 20 to 40 amperes, with the fuses designed to open the circuits. The drop in potential in the resistors is negligible.

Current Transformers

Current transformers are connected directly in the line, and the current coils of the meters are connected in the secondary. When current is flowing in the primary winding, the secondary circuit must be kept closed, either short circuited on itself or closed through the current coils of the meters, relays or other devices operated thereby. Upon open circuit, there is a possibility of dangerously high voltages being induced at the terminals. This is due to the fact that for a given primary current a definite secondary current is going to flow in the secondary, of a value depending upon the turn ratio. Only a small component of the primary current is required to magnetize the iron and any greater flux which would be set up by the primary current is ordinarily neutralized by the oppositely flowing secondary current. It is obvious that if the secondary is open, no secondary current could flow, and there would be no secondary flux set up to neutralize that set up by the primary; consequently the iron would be magnetized to a maximum value, thus generating a very high secondary voltage. In this respect as well as in many others, the current transformer differs from the potential transformer, for in the latter the voltage across the primary only varies with the fairly constant fluctuations of the power supply, and when the secondary current reduces to zero, the primary current is also reduced. But in the case of the current transformer the line will continue to force current through the primary, even though the secondary be open. The opening of the secondary does not introduce enough impedance in the line to appreciably reduce the primary current. In other words, a current transformer is going to do everything it can to maintain its flow of secondary current, even though the secondary load impedance is varied over wide ranges.

Current transformers, in common with voltage transformers, have ratio and phase angle errors, but in most switchboard measurement installations they may be neglected, unless high precision tests are required.

Connection of Several Instruments on Transformers

It is usually found convenient or necessary to connect several instruments, meters or relays on the same set of transformers, with the current coils all connected in series and the voltage coils in parallel. The transformers are generally designed with sufficient output capacity to operate several instruments.

The ability of a transformer to operate a secondary circuit is specified as its "Burden Rating." By "Burden" is meant the load on the secondary circuit, and the "Rating" is such as to operate this burden within the specified limits or error. As defined in the A.S.A. Standard #C-42-(30.80.025)

"The burden of an instrument transformer is that property of the circuit connected to its secondary which determines the flow of true and reactive power from the transformer. It is expressed either as total ohms impedance, together with the effective resistance and reactance components of the impedance, or as the total volt-amperes and power factor of the secondary devices and leads.—"—The impedance expression is more applicable to current transformers, and the volt-ampere power factor expression to potential transformers."

The Rated Burden of an instrument transformer defines a burden which can be carried at a specified limit of error, for an unlimited period without causing the established limitations to be exceeded C-42-(30.80.070).

The phase angle and ratio of a potential transformer are affected by its secondary burden. This burden consists of the potential circuits of a wattmeter, voltmeter, etc. Variations of the line voltage also affect the errors, but since the voltage is fairly constant in practice, the small variations need not be considered.

In the current transformer, the phase angle and ratio errors depend upon the secondary burden and also upon the primary current. The primary current varies over a wide range because of load conditions, and the errors are different for each value of current, consequently wattmeters and watthour meters can be corrected for only one value of current.

The power factor of the line in no way affects the ratios and phase angles of the instrument transformers, and should not be confused with the power factor conditions and effects of the secondary burdens.

In indicating instrument and recording instrument applications it is usually the practice to disregard the transformation errors when calibrating the scales. Thus such instruments read the values of amperes, volts, or watts in the secondary circuits of the transformers multiplied by the total ratio of transformation. However, where desired for work of higher precision, data obtainable from the manufacturers correction curves may be applied.

As stated above, instruments for use with instrument transformers are calibrated in terms of secondary current values, but their scales are generally marked to read the primary values. The ratio between the values applied to the instrument coils, and those in the primary circuits is the "Calibration Constant" and this must obviously be equal to the nominal ratio of transformation. In the case of watt-and watthour-meters, this is equal to the product of the current transformer ratio and the voltage transformer ratio. (Times 2 for a 2-element wattmeter, when calibrated on a single phase load as usual, with both elements energized or times 3 for 3-element watt-hour meters).

It will be apreciated from the above that when several instruments etc. are to be operated from the same transformers, care must be taken to keep the total burden of the instruments within the rated burden accuracy limits of the instrument transformers.

Combined Burden of Several Instruments

Because the power factors of various instruments and relays, together with their connecting leads, differ materially, the total burden must be determined by vector addition as explained below.

Combined Current Burdens

The burden of a current transformer is composed of the impedances of all the instrument current coils in series. The resulting total burden is generally expressed in terms of Impedance Ohms, at the rated amperes.

When two or more instruments etc. are used in series, the value of the resultant burden in impedance ohms can be calculated from the resistance ohms and the reactance ohms of each item, these values being obtainable from the manufacturer.

To obtain the total impedance, proceed as follows:—

The total resistance is the sum of the resistance on the individual instruments and the total reactance, that of the individual reactance ohms. The total impedance is the square root of the sum of the squares of these total values:—

Total Burden, Impedance, Ohms

$$R_z = \sqrt{(\text{Total Resist})^2 + (\text{Total React})^2}$$

(Note. In special cases it may be desired to obtain the burden in terms of volt-amperes and power factor, in which case proceed as directed by the equation and example under the heading "Combined potential burdens."

Example *

An ammeter, a recording wattmeter, a power factor meter, a watt-hour meter and an over-current relay on 60 cycles 120 volts.

	Current Circuit Z, Ohms	R, Ohms	X, Ohms
Ammeter	.011	.01.	.002.
Recording Wattmeter .	.24.	.13	.20
Pow. Fac. Meter	.016	.016	.05
Watt-hour Meter	.023	.009	.021
Relay	4.32	2.16	3.74
Total		2.32+	4.01+

$(2.32)^2 = 5.38$

$(4.01)^2 = 16.08$

21.46

$\sqrt{21.46} = 4.63. = Z, \text{TOTAL}$

Current Burden for Long Connecting Leads. In the case of long leads sometimes used between the trans-

* The data in these Tables are typical of certain Westinghouse switchboard Instruments, Watthour Meters, and Relays. All manufacturers will gladly furnish data on their various types.

former locations and the switchboard, their burdens should be added to those of the instruments. For power circuit frequencies we may assume that the leads are practically non-inductive and thus the resistance values as given in copper wire tables may be used.

Burden Conditions in Polyphase Circuits

In some of the common polyphase connections of current transformers, part of the circuit carries current from two transformers, and hence constitutes a burden on both transformers. A familiar example is the case of three ammeters, or one power factor meter operated from two current transformers. This part of the burden is more difficult to calculate. The problem is complicated by the possibility that the currents in the phases may be equal and that the effective burden may change on this account. In such cases, a reasonable approximation would be to consider the total burden as being equally divided between the transformers.

Combined Potential Burdens

The burden of a potential transformer is composed of one or more instrument or relay voltage coils in parallel. The resulting total burden is most easily calculated by finding the sum of the watts of the various units and the sum of their reactive volt-amperes (VARS) and finding the resultant volt-amperes by applying the following equation:—

$$\text{TOTAL BURDEN, VA, } = \sqrt{(\text{Total Watts})^2 + (\text{Total Vars})^2}$$

$$\text{BURDEN POWER FACTOR, } = \frac{\text{TOTAL WATTS}}{\text{TOTAL VA}}$$

Example

Using the same typical group of instruments as before, we have in the voltage circuit,—

	Va.	Watts	React. Va.
Ammeter	0	0	0
Recording wattmeter ..	12.9	12.09	0
Power Factor Meter	3.7	3.7	0
Watt-hour meter	8.7	8.7	3.6
Relay	23.7	3.45	22.7
		21.55	31.3

$(21.55)^2 = 465$

$(31.3)^2 = 980$

1445

$\sqrt{1445} = 38 = \text{TOTAL BURDEN}$

Varmeters

Miniature Autotransformers are used to rotate the voltage phases of 3 phase wattmeters 90 deg, so as to measure Vars (Reactive Power). These autotransformers consume energy. Therefore varmeters complete require more operating power in the voltage coil circuits than corresponding wattmeters. An exception is the case of 2 phase varmeters, in which the phases are rotated 90 deg by cross-phasing the voltage connections, without the use of autotransformers and therefore the coil constants are the same for 2 phase varmeters as for wattmeters.

Betatron Energy Raised to 160 Million Volts

World's most powerful electron accelerator at the General Electric Research Laboratory improved to raise the effective voltage of the unit from 100 million to 160 million

BY A RELATIVELY simple improvement, the 100,000,000-v betatron in the General Electric Research Laboratory, most potent atom-smasher now in operation, may soon have its output energy raised to 160,000,000 v. This was announced recently by Dr. C. G. Suits, G-E Vice President and director of the Research Laboratory, who credited W. F. Westendorp, of the Laboratory's X-Ray Section, with responsibility for the improvement.

The betatron [1] operates on principles similar to that of a transformer, in which the flow of alternating current back and forth in one coil, called the primary, produces a comparable flow in another coil called the secondary. Primary and secondary are connected magnetically, since they are both wound on the same iron core. The ratio between the voltage in the primary and that in the secondary is the same as that between the turns of wire in the two coils.

Alternating current, as commonly used, reverses itself 120 times each second. Starting from zero, it flows one direction, building up to maximum voltage, then returning to zero. After that it does the same thing in the opposite direction with 60 complete cycles each second. An electric current consists of a flow of electrons between atoms. Thus the electrons in the secondary of a transformer are constantly oscillating back and forth, first drifting in one direction, then $\frac{1}{120}$th second later, going the other way.

In the betatron, the secondary coil is replaced by a vacuum tube called the "doughnutron" from its shape. The electrons originate from a heated filament and flow in open space instead of through the atoms of a wire. They are held in their proper orbit by the magnetic field of the huge electromagnet in which the doughnutron is placed.

If the electrons remained in the tube continually, they would first revolve one way, then stop and reverse, but the trick is to get them out while they are moving at maximum energy. As the current builds up from zero to its maximum voltage in the first quarter cycle, lasting $\frac{1}{240}$th second, they make 250,000 turns and travel 800 miles. Then, before they go into reverse and lose energy, they are shifted from their orbit, and made to hit a tungsten target, generating a beam of high voltage X rays.

For a full half cycle, from the time the current is at a maximum in the negative direction, while it is returning to zero, and then building up in a positive direction, the voltage is positive and in the proper sense to speed the electrons. This offers the possibility of accelerating them for nearly twice as long as with the present method and consequently increasing their energy. However, the difficulty is that while the voltage is passing from zero to its positive maximum, the magnetic field is in the wrong direction for guiding the electrons in their orbit.

The method Mr. Westendorp devised for overcoming this difficulty is called "DC bias." In addition to the alternating current, a direct current can be applied to the electromagnet. This shifts the zero line from the middle of the current wave to its bottom, and nearly the whole of the rise can be utilized.

Editors Note: To those unfamiliar with the biasing principle, the diagram shown in Fig. 1 may be helpful. Here, in the upper part of the illustration is shown an alternating current wave. It

[1] For a description of the G-E Betatron, see *Power Plant Engineering*, April 1946, page 61.

One of the most interesting disclosures from the General Electric Research Laboratory at Schenectady is the one described in this short article, the fact that the voltage of the giant Betatron at Schenectady has been raised from 100 million volts to 160 million volts. That this can be done virtually without changing the betatron itself in any way is really a remarkable accomplishment and yet, it is very simple. The idea might have occurred to anyone having worked with electron tubes for the principle involved is one which is used every day in electron tube operation, but it remained for W. F. Westendorp to think of it in connection with the operation of the Betatron. We won't tell you here how it is done since it is explained clearly in this article but after reading it you will no doubt wonder as we did why somebody did not think of it before. By the simple application of common sense it was possible to almost double the accelerating voltage of this new research tool

varies from zero to maximum in the positive direction back to zero and then to maximum in the negative direction. At (B) that is, in the middle diagram is shown a steady positive voltage with a value of E, the same as the maximum voltage of the A-C wave shown above. At (C) is shown the result of adding or superimposing the steady positive voltage on the A-C voltage. As will be noted it has exactly the same characteristics as it had before the steady voltage was applied but the value about which it oscillates is now E rather than zero. In other words, the voltage never goes negative with this arrangement. As a consequence the accelerating voltage can be applied for almost a half cycle instead of the quarter cycle shown in the upper part of the diagram. Fig. 2 is a simple electrical diagram showing how a biasing voltage can be applied. This is not necessarily the way it is actually accomplished in this improvement of the betatron but it will serve to illustrate the principle.

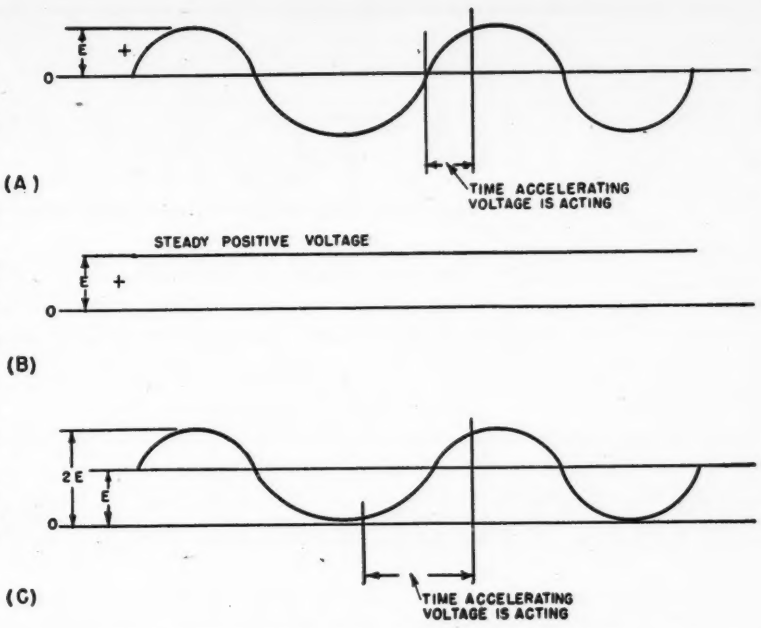


Fig. 1. Diagram illustrating the principle involved in raising the accelerating voltage of the betatron

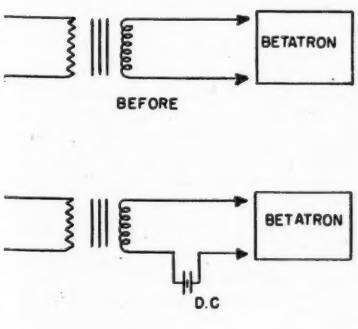
"By the use of this principle, and some other improvements that may be used with it, it is possible to get substantially higher energies with the same weight of magnet," said Dr. Suits. "We are modifying our 100,000,000-v machine for biased operation and expect to obtain 160,000,000 v with relatively small changes in the core of the magnet.

"Since no serious difficulties of this method have yet been discovered, the biased betatron may very well replace the earlier type, especially at higher energies. A 10,000,000 v biased betatron has already been built in our laboratory for experimental operation. One for 50,000,000 v is now under construction for further study of the principle."

Dr. Suits also revealed that the G-E laboratory is constructing two other devices for producing high-energy particles for atomic study. One is the "synchrotron," devised independently by a Russian physicist, J. Veksler, and Dr. E. M. McMillan, of the University of California.

"This device," he said, "employs a magnet and a doughtnut-shaped vacuum tube similar to the betatron. The vacuum tube, however, incorporates a high energy resonant cavity energized by a radio frequency oscillator.

Fig. 2. Electrcal circuit diagram showing the biasing principle used in improving the betatron



"Electrons are injected into the doughnut cavity as relatively high energies and take a circular path because of the magnetic field. The chief accelerating force is provided as the electrons cross the resonant cavity, very much as in the cyclotron. That is, before the negatively charged electrons reach this cavity its polarity is changed so as to give them an additional push. By the use of this principle one may hope to accelerate particles to still higher energies than with the biased betatron, using a given weight of magnetic material."

Dr. Suits said that the G-E laboratory has under construction a modified synchrotron, or "sigmatron," as it is also called, for 70,000,000-v particles. Following a design of Dr. Herbert C. Pollock, of the laboratory's nuclear physics group, it will be combined with the betatron principle, which will speed electrons to 2,000,000 v energy before they are fed into the synchrotron cavity. This principle is also being used on other large synchrotrons now under construction.

The other new atom-smashing device which G-E scientists are building is an outgrowth of wartime work in radar. "This greatly advanced the art of radio circuitry and electroncs at very high frequencies," explained Dr. Suits. "From this work has come a very much fuller understanding of the conduction of electric waves through hollow guides, as well as the development of tubes for the production of microwave radio energy at high power levels. These two advances provide the basic elements of linear accelerator.

"In one form this device may employ a hollow tube energized by a very high frequency oscillator. Since even the very high power levels available are insufficient for continuous operation, the radio frequency power is applied in regular pulses. Electrons injected into one end of this wave guide may ride the travelling electric wave from one end of the tube to the other, and be thereby accelerated to high energies.

"To adjust the electric wave velocity in the guide to the increasing velocity of the particle during acceleration, the accelerating tube is generally built in a series of tuned cavities. The electric constants of these cavities permit a choice of wave velocity, so that either electrons or heavier particles may be injected and successfully accelerated on their straight path down the axis of the wave guide."

The G-E linear accelerator, one of a number being constructed in various laboratories in the country, is an experimental one to permit an evaluation of the advantages or disadvantages of the method. With a wave guide length of about 5 ft, it will accelerate electrons to 4,500,000 v. It is being built under the direction of E. J. Lawton and W. C. Hahn.

JUST OFFHAND, you would think that an oxy-acetylene flame and plastics would be a bad mixture. However, plastic powders are being flame sprayed on surfaces. The powdered material passes through the flame in milliseconds of time, too fast for the powder to melt before it comes in contact with the object being sprayed.—*The Ohmite News.*

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

What Happened At Bikini ?

What caused the public to undergo a change of attitude regarding the atomic bomb after Bikini? . . . Were the Bikini tests a "flop" as some observers claimed? . . . Why is nuclear energy so vastly different from chemical energy? Were the Bikini bombs of low efficiency? . . . What about the radioactive effects? . . . Was Bikini worthwhile? . . . Why has test Charlie been called off? . . . Does Bikini strengthen the need for international control of atomic energy? What did the air force learn? These and many other elements of the Bikini tests are answered in this article.

By ANDREW W. KRAMER

Managing Editor, Power Plant Engineering

Accredited Correspondent, Operation Crossroads

FOUR MONTHS have now elapsed since the two atomic bombs were exploded in the Bikini tests and nearly all of the noise and commotion that surrounded these tests last summer has died down. The great task force that conducted the tests has been demobilized and the many ships that filled Bikini Lagoon during the early months of the year have been returned to their respective ports in other parts of the world. At the time of this writing some of them are still radioactive. Two official reports made by evaluation boards were submitted to the President but they elicited only casual comment and the public has now all but forgotten the Bikini tests.

Fig. 1. Here is the camera record of the atomic bomb blast on July 1 a few microseconds after detonation as made by an electrically operated aerial camera miles away from the blast

All photos courtesy Joint Army Navy Task Force One.

This last fact is unfortunate, if not tragic, for it is associated to a high degree with a profound change in public attitude toward the atomic bomb. Before the Bikini tests, ever since the atomic bombs were dropped on Hiroshima and Nagasaki, the world stood in awe of this great new cosmic force which in one awful blast could wipe out a large city, kill and maim over a hundred thousand people and in a few days bring about the surrender of a still strong army of some five million men. All through the year the horror of the atomic bomb was uppermost in people's minds.

Since the Bikini tests, however, this feeling of awe and horror largely has disappeared; it has been supplanted by a sense of relief and a feeling of security quite inconsistent with the grim realities of the situation. Somehow the Bikini tests have caused people to regard the atomic bomb with far less apprehension than they did before the tests were made.

Why is this? What happened at

Bikini to bring about this change in public opinion toward the danger of the atomic bomb?

There may be other contributing reasons but two primary factors stand out; first, there was a widespread misunderstanding of the nature and the purpose of the tests at Bikini and, secondly, the American newspaper men who witnessed the tests were disappointed in the first test as a spectacle and as a consequence, their dispatches led the people back home to assume that the atomic bomb was nothing to be seriously worried about. One of the newspapermen wrote in his paper that "the show was a flop." He was looking at nuclear physics with a brain limited to the understanding of a firecracker.

As a consequence of a great "build-up" the public had been led to believe that one bomb would sink the entire fleet at Bikini, that it would kill all the animals aboard the target vessels, that it would blow a hole in the bottom of the ocean and thus set up tidal waves that would cause damage thousands of miles away. When we stopped at Honolulu on the way to Bikini we found that the people of Hawaii were apprehensive about the effect of these possible tidal waves.

Despite plenty of evidence given them to the contrary, these views were held by many of the newspaper men accompanying the expedition. On the way over, there were numerous "briefing" conferences aboard the *U.S.S. Appalachian*—lectures and informal discussions with the staff officers of the press group concerning the effects of the blasts, but they seem to have little effect. From the beginning it was obvious that the newspaper men did not have the necessary background knowledge to understand the scientific nature of the tests. There was, for example, great misunderstanding regarding the question of temperature and pressure. The fact that the nuclear reaction in the atomic blast is associated with temperatures of forty or more million degrees led some of them to think that ships in the immediate vicinity of the blast would melt. Mention by the scientists of great winds produced by the blast led a certain well-known newspaper man to predict that all of the palm trees on Bikini Island would be torn away. This resulted in great apprehension concerning the safety of the officer's club with its ample stock of liquor on Bikini Island.

Of course, none of these things happened, nor did anybody with any scientific knowledge at all expect them to happen. Only a few ships were sunk. The blast created no tidal waves; it did not blow holes in the bottom of the ocean, it did not melt any ships nor did it damage Bikini Island; not a single palm leaf on the island was disturbed and the officer's club withstood the atomic blasts far better than it stood up under the repeated attacks of several hundred thirsty officers, newspaper men civilian scientists and VIPs.

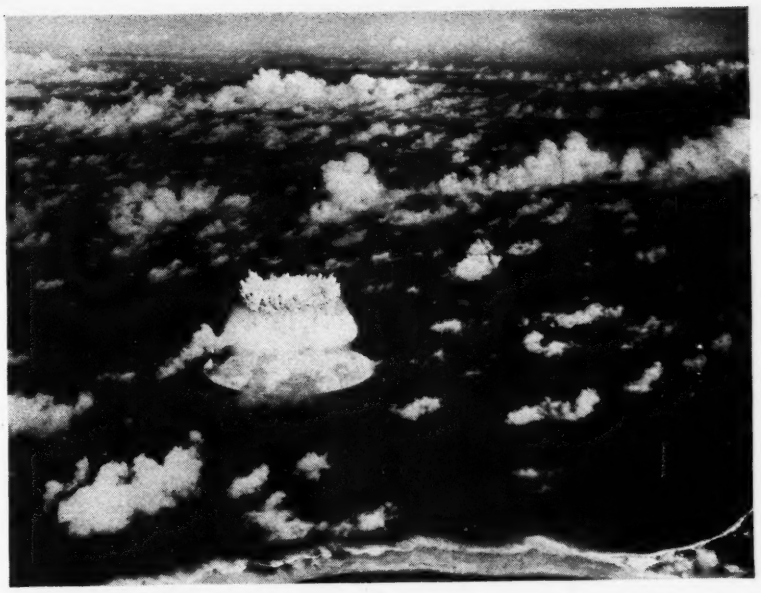


Fig. 2. From the air the Baker Day explosion took the appearance of a derby hat for a brief instant as water, spray and steam boiled skyward out of Bikini lagoon

As a consequence, and coupled with the fact that the *Appalachian*, the press ship, was 18 miles away at the time of the first blast, the press representatives were only too eager to conclude that the atomic bomb is, after all, just another weapon and they passed this mistaken notion on to the American public.

As one noted writer commented in regard to this state of affairs, whatever Bikini proved or did not prove concerning atomic bombs, it proved conclusively that the American press is incapable of covering the subject of atomic energy. The reporters never caught on to the basic facts?

The two reports submitted by the evaluation boards told quite a different story. Though the language is calm and collected, these reports stress the terrible destructive powers of the atomic bomb to both materials and personnel. The atomic bomb dropped at Bikini, the report says, damaged more ships than have ever before been damaged by a single explosion.

Number of Ships Sunk Unimportant

The fact that comparatively few ships were sunk is not of great importance in evaluating the Bikini tests. It was not the purpose of the tests to sink a large number of vessels; this, as a matter of fact, would have defeated the purpose of the test which was to obtain

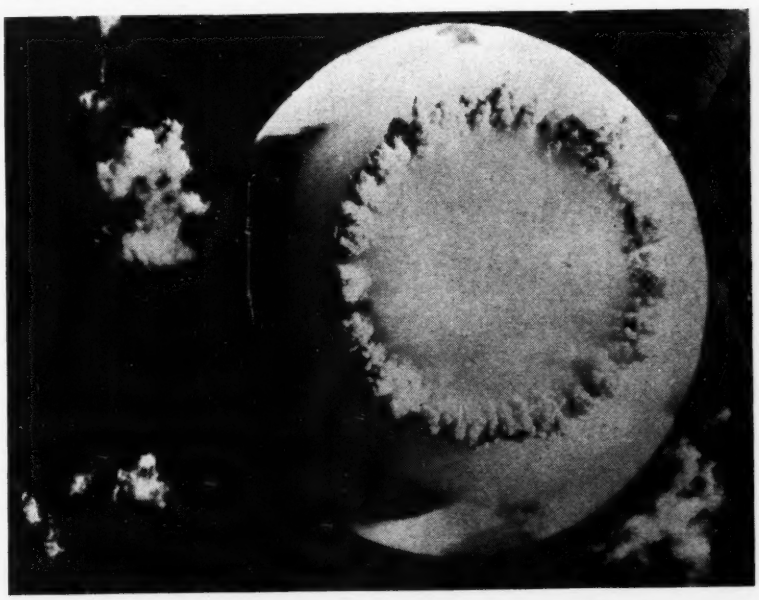


Fig. 3. This picture taken from a drone plane almost directly overhead at the instant of detonation was made at approximately the same instant as the picture shown in Fig. 2

Fig. 4. Above. Ships of the Bikini target fleet are silhouetted in a glare many times brighter than the sun an instant after the Able Day atomic bomb explodes

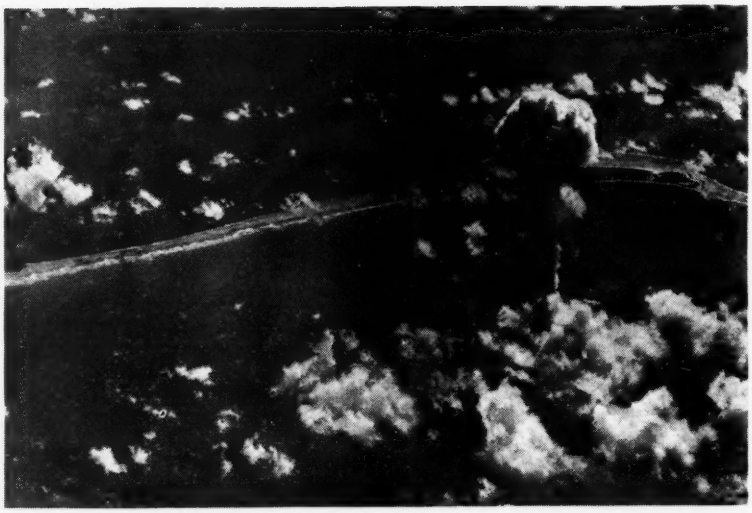


Fig. 5. Right. Swirling and boiling like a living thing this atomic plume with its mushroom cap soared over the Crossroads target fleet seconds after the Able Day explosion. This photograph of the plume and the lagoon area was made from a photo plane

Fig. 6. Below. Sweeping out in all directions, this haze of water, steam, spray and radioactive substance obscured all but the extreme outer fringes of the Crossroads target fleet a few minutes after the Baker Day blast. This photograph was made by an automatic camera mounted in one of the photographic towers on a nearby island

quantitative data in regard to the effect of pressures and temperature throughout the blast area. The ships of the target array were disposed in such fashion as to provide this data. One must keep in mind that in the underwater test on July 25 the atomic bomb was detonated in an area of open water approximately three quarters of a mile wide and almost a mile long. In that area there were no ships at all. Naturally an extremely large proportion of the energy of the blast was expended in raising several million tons of water a mile high into the air. Under such conditions it is quite easy to understand that not many ships would be destroyed. Yet, it did sink two large ships almost at once and another large vessel, the Japanese battleship *Nagato,* sank several days later after the blast as a result of underwater damage.

If, because of the distance from the aerial blast on July 1, the observers on the *Appalachian* were disappointed, they should have been properly impressed by the magnificent spectacle of the underwater blast on July 25. In that test, we were only 10 miles away. It does not seem possible that anyone who saw that tremendous column of water, a half mile wide, hurled a mile or more into the air could underestimate the energy involved in the blast.

Nuclear Energy vs Chemical Energy

No doubt, to really appreciate the danger of the atomic bomb one must understand something of the difference between the energy relations in a nuclear reaction as compared to those involved in an explosive chemical reaction as in, say, TNT or nitroglycerine.

Despite the violence of the explosion of TNT, the amount of energy liberated is less than that liberated in the combustion of an equal amount of coal or gasoline. The combustion of a pound of high octane gasoline will liberate

around 20,000 Btu, compared to a release of only 8800 Btu per pound of TNT. The burning of a pound of gasoline-air-mixture in the cylinder of an internal combustion engine however takes about one-tenth of a second whereas in in the explosion of TNT, the entire reaction is over in a few microseconds.

Now, consider the nuclear reaction in the atomic bomb blast. This also is fast, that is, it is completed in a matter of microseconds but compare the energy release with that of gasoline or TNT! Whether the reaction be slow or fast, the fission of one pound of Uranium 235 releases *39 billion Btu!* One has only to think of the difference between 39 billion and 8800 to understand the enormous difference between the atomic bomb and any ordinary chemical energy type of bomb. The 39 billion Btu released in the fission of one pound of uranium 235 is the equivalent of 1400 tons of good coal.

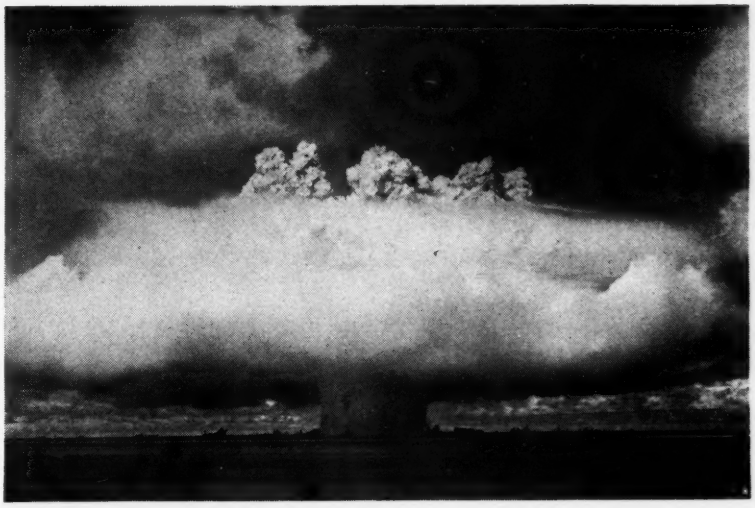


Fig. 7. Above. The rising column of water enters the first phase of the characteristic mushroom. At the base of the column of water, in the left foreground is the cruiser "Salt Lake City"; in the right foreground is the Jap battleship "Nagato"

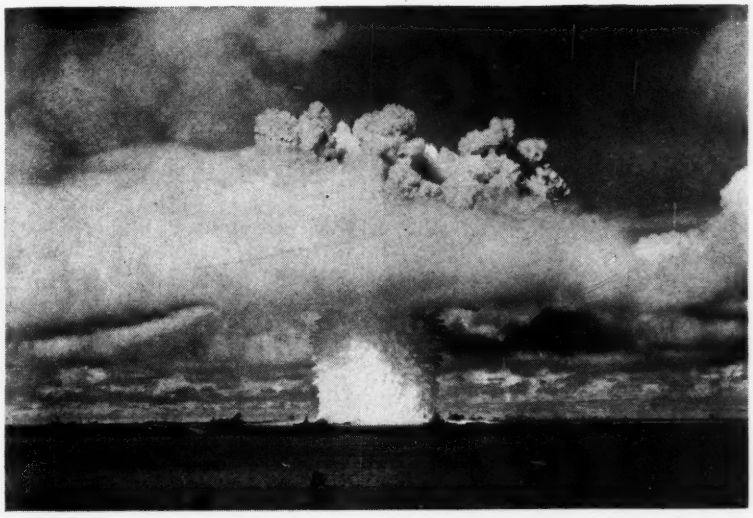
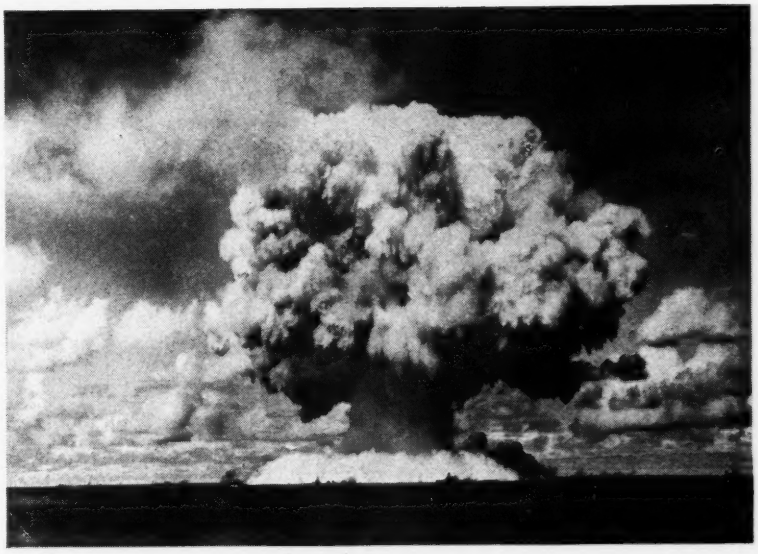


Fig. 8. Left. Cloud formation at peak shortly before the rapid disintegration of the mushroom shape, and as the column of water starts to fall

Fig. 9. Below. Another photograph showing the cloud formation near its peak, before the disintegration of the mushroom shape. Here the water is beginning to fall rapidly



In other words there is so much more energy involved in the atomic bomb blast than in the blasts of any other kind of explosive that there is almost no camparison.

It is not the energy liberation alone that marks the great difference between the atomic bomb and a bomb utilizing molecular or chemical energy. The temperature and radiation effects are also vastly different. The explosion of a charge of TNT results in a temperature of a few thousand degrees; this is as nothing to the temperatures of millions of degrees attained in the nuclear reaction of the atomic bomb blast. Of course, it should be understood that when we speak of a temperature of millions of degrees, this refers only to the temperature at the center of the blast, and that it is a way of expressing thermal velocities. All heat energy is a matter of motion—mo-

Fig. 10. Looking for all the world like a giant cauliflower head suspended to an ever stretching neck, the cloud of smoke and gas resulting from the Able Day blast billows upward

tion of the molecules and atoms. At ordinary temperature, those involved in ordinary combustion processes, the velocities are measured in miles per second. In the nuclear reaction, the nuclei fragments resulting from the fission process fly apart at velocities of thousands, perhaps even a hundred or more thousands of miles per second. These high velocities can also be expressed in terms of degrees and that is what is meant when temperatures of millions of degrees are referred to.

The radiation effects accompanying such extremely high temperatures are naturally severe. One has only to read the eyewitness accounts of observers at Hiroshima after the blast, of the terribly burned condition of the bodies of the victims to realize the intensity of the radiation. One could be 1000 feet away from the blast of a block buster such as were used in the London raids and unless hit by fragments live through it but as was shown in the Hiroshima blast practically nobody within a mile of the atomic bomb blast has much expectation of survival.

Much has been said in regard to the effectiveness of the two atomic bombs exploded at Bikini. They have been called "primitive" type bombs, implying that very much stronger bombs could have been used. Probably this is not true, but whether it is true or not, the bombs used in the Bikini tests were sufficiently strong to provide the task force with the data and information it desired. Their conservatively safe distance from the burst led many observers to entertain the initial opinion that the bomb dropped in the first test was somewhat under par. It is now quite obvious, however, that the energy was of the same order of magnitude as in the case of the previous atomic explosions. According to the report of the President's Evaluation Committee, the Bikini bombs were between the highest and the lowest of the bomb's three predecessors. It is probably true, that stronger bombs could have been used; indeed, it must be assumed that bombs of very much greater destructiveness will be produced in the future, but for the purpose of the tests at Bikini, stronger bombs were not necessary. Stronger bombs might have sunk more ships but as already mentioned, it was not the purpose of the tests to sink many ships. Even if the strength of future atomic bombs are no greater than those used at Bikini, it must be realized that future wars will not employ atomic bombs singly but by hundreds and perhaps thousands. Dr. Robert Oppenheimer, under whose direction the bomb was developed at Los Alamos, New Mexico has testified that in the not too distant future atomic bombs will be easy to make and that they will cost no more than $1,000,000 each. There is ample uranium and thorium scattered throughout the earth's crust to manufacture them by the thousands, once adequate plants have been built.

If a million dollars as the cost of a single bomb seems a great deal, remember that in war a million dollars is an extremely small item. If a million dollar atomic bomb can destroy even a single hundred million dollar battleship, it must be considered an efficient weapon. Indeed, as has been indicated by many of the scientists engaged in the development of the atomic bomb, it is today the cheapest explosive, the cheapest form of destruction we have. The Bikini tests proved that; never before in the history of warfare was so much destruction effected by a single bomb.

Radioactive Effects

In nearly all of the appraisals of the tests, too much emphasis has been given to the structural damage or the lack of it to the ships and not enough to the radioactive aspects of the blasts. These were terribly deadly and are of the utmost significance in future use of the atomic bomb. Those who watched the cloud of death that spread over the ships at Bikini must have found it obvious that the invasion of Normandy and before that, of North Africa, would have been impossible had the enemy had the atomic bomb. Had the German's exploded a few atomic bombs in the air and under water, it not only would have sunk all the invasion craft but would have killed every man aboard them. If any did escape the blast and heat, they still would have been marked for death by the deadly, penetrating radiation. Men knowing that they were so marked for death or sterilization would not have fought on; their morale would have disappeared to the vanishing point. There would have been no invasion.

And so also, had the German's possessed the atomic bomb, they would not have had to wait for an invasion. By means of rockets fitted with atomic war heads or even by dropping atomic bombs from airplanes they could have destroyed all of England long before an invasion could have been organized.

Those, who at the present time feel that we should keep the atomic bomb to ourselves should consider these thoughts. Fundamentally, there is no secret to the atomic bomb. The scientists of almost every country in the world know the basic principles. While the secret of its manufacture is now possessed largely by us, it will take only a relatively short time before other nations will have it. As far as I am concerned,

there is only one possible solution to the problem of atomic energy and that is to place the use of atomic energy for any and all purposes in the hands of an international atomic energy authority as recommended in the Baruch Report. Only by such a plan can we hope to avoid a future atomic war.

Was Bikini Worthwhile?

As far as the Bikini tests are concerned, they were definitely worthwhile. True, by and large, the tests probably did not disclose any strange or unusual phenomena that was not anticipated but until actual quantitative data is at hand it is difficult for the designer to do his work. Extrapolation from small-scale tests or from data gathered from dissimilar conditions is helpful but information from full scale tests is always necessary. Whether the atomic bomb renders navies obsolete is beside the point; if we are to have any navy at all it is only reasonable that military and naval designers should be supplied with all the information that can be obtained. There can be no question about the atomic bomb in future wars. If there is to be another war it will be an atomic war and despite the fact that we should do all in our power to prevent such a war, if it does come, we should have a navy that is in some way able to resist atomic weapons.

In conclusion, one other thing about the Bikini tests should be emphasized; their organization and execution. This was magnificent and commanded the admiration of all who took part in it.

It was a wonderful example of co-operation and coordination between the various groups involved. A vast amount of study went into the planning of the tests and the actual execution required split second timing of the highest order. As may be recalled, according to one commentator, broadcasting from Kwajalein, the bomb went off three seconds too soon. That this was not true was easily verified by noting the angles of the blast marking on the target vessels. These showed that the bomb exploded somewhere between 500 and 800 feet above the water—600 feet would be a fair estimate. This was probably within 100 feet of the chosen altitude. If the bomb had exploded three seconds earlier, at the high rate of speed it was falling, it would have exploded at a height of somewhere around a mile. All the evidence shows that this was not so. It is true the explosion occurred several hundred yards west of a point directly above the target ship *Nevada* and therefore entirely west of the closely spaced array of capital ships.

A word about "Test Charlie." It may be recalled that a third test was considered, a deep water test. Even last summer, when we were at Bikini plans were made to hold this test some time next spring but a brief announcement from the White House recently has postponed the third atomic bomb test indefinitely. The reason for the postponement of this test has to do with our national security. It is felt that the operation would tie up a very large proportion of our skilled scientists and seamen and that with world conditions being what they are, this might jeopardize our national security during a period of international tension. Scientists including a large portion of this country's top nuclear physicists, would be engaged in testing the underwater blast, and would be at Bikini instead of at work on much needed research here at home.

Another factor contributing to the postponement of the third test is the cut in military appropriations. It seems to be felt that we could not afford to take the $35 million dollars needed for the test out of the general appropriations needed to run the Army and Navy.

As far as the technical problems involved in the underwater test are concerned, these also have been mentioned but they could be surmounted. There is no question regarding the complexity of the problems involved in exploding an atomic bomb some 3000 feet below the surface of the water. How to lower such a bomb to the right spot while it is subject to undersea cross currents, and how to make it withstand the terrific pressures at that depth—around 12,000 lb per sq in.—still are not worked out. Nor has the intricate matter of detonating the bomb at such a depth from a surface vessel been solved.

All of these technical phases of the problem, however, could no doubt have been worked out in time for the scheduled explosion if other factors had not been of greater importance.

The postponement of test "Charlie" does not mean that they have been given up entirely. Prospects are that it will still be held at some time in the future.

International Control of Atomic Energy

As already implied, unless the whole problem of atomic energy can be handled on an international basis there seems little hope of averting a future atomic war. If we proceed on the assumption that we can keep ahead of other nations in our technical knowledge of the atomic bomb, then most certainly, we are going to run into an atomic weapon armament race which can only end in an atomic war. And if that happens, whether we are in the lead or not, we will still lose. What the Bikini tests proved in this respect has not been told to the public. The public knows very little of the success of the "drone" operation at Bikini, that is, the use of radio controlled airplanes. These were remarkably successful and the army air force as well as the naval air force learned a great deal from the work at Bikini. After the tests, it may be recalled two of the drones were flown all the way from Kwajalein to San Francisco and just outside of San Francisco these drones dropped their bomb loads into the waters of the Pacific, all by remote radio control. One has only to let ones imagination play to realize what will happen if a third world war transpires in which such radio controlled planes equipped with atomic war heads are used by the thousands. Whatever defenses we might work out would prove useless because the destructive forces at work would be so great that even if a few of the missiles got through they would suffice to destroy the defenses. Even now, research in the use of radio controlled planes and rockets is going ahead at great speed and no one familiar with the progress of science in the past can doubt that in the future we will be able to send flying bombs over distances of thousands of miles with unerring precision. Bikini showed not only what atomic bomb blasts do to naval vessels it also showed us how to use the drone type of flying weapon. In short, Bikini only makes international control of atomic energy more necessary.

Fig. 11. The end of the "Sara." Gamely flashing the big 3 on her flight deck until the last, the gallant old aircraft carrier "Saratoga" sinks beneath the radioactive waters of Bikini Lagoon. The "Saratoga" sank 7½ hours after the Baker Day blast

Corrosion of Plant Equipment by Steam and Water—II

By **R. C. ULMER** Technical Director, Industrial Dept., E. F. Drew & Co., Inc

THE corrosion problems of feed lines, pumps, heaters and economizers are quite similar as they all come in contact with the same general type of water. The chief difference is one of temperature resulting from the use of heaters and economizers.

The same general theory of corrosion as outlined in Part I published in the October issue applies; that is, iron is very reactive towards water especially if a low pH exists and/or dissolved oxygen is present. As with boiler corrosion the best procedure for preventing this type of corrosion is to maintain a film on the surface of the iron. This separates the iron from the water and corrosion is decreased.

In the case of boiler feedwater problems, treatment to produce and/or to maintain this film cannot be so extensive as improper conditions may be set up in the boiler, for example excessive alkalinity, total concentration, etc. Corrosion problems are much worse in pure feedwaters, that is those having low solid concentration, than in those not so pure. This is due to two factors:

(1) Iron and other metals in general are much more reactive towards pure water because there is less chance of a protective film forming on the surface.

(2) The effects of corrosive materials, for example carbon dioxide, acids, etc., are more pronounced in the case of pure water. This is because pure water has little "buffer action" which tends to counteract the change of hydrogen ion concentration, for example, by carbon dioxide.

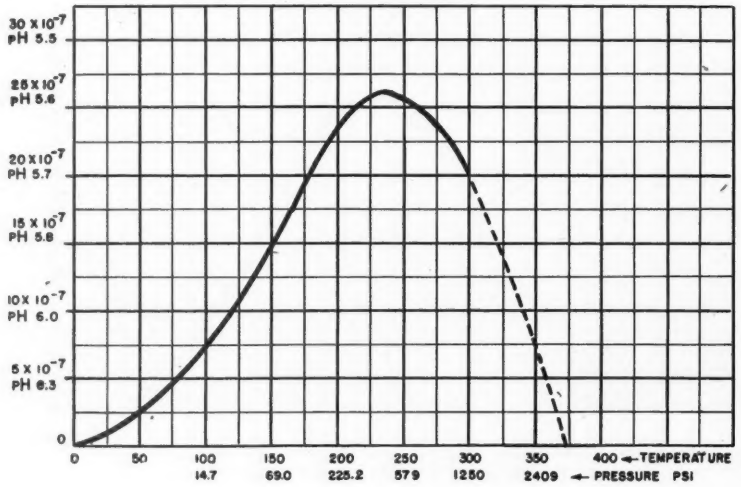
Although it is unfortunate that pure water is more corrosive to metals than less pure water, it is fortunate that the remedies or means of prevention are more effective in the case of pure water than in the case of less pure. Therefore, corrosion usually can be prevented.

Effect of Temperature

Much controversy has taken place regarding the influence of temperature on corrosion involving boiler feedwater. It is generally admitted that iron in contact with water is much more reactive at high temperatures than at low, but the reason for this and therefore the means for counteracting the corrosion is not so generally agreed on. There is much mention of the fact that pH applies to room temperature, that is 77 F, and yet that it is used to discuss conditions at much higher temperatures, for example up to 450 F. Various curves, see Fig. 1, have been presented showing the change of some particular pH or hydrogen ion concentration with temperature.

Apparently many overlook the fact that as the hydrogen ion concentration increases with temperature the hydroxyl ion must increase at the same rate since the dissociation of water $H_2O = H^+ + OH^-$ is largely responsible for the change. In other words even though the pH does change with temperature the relative ratio of H^+ to ^-OH is the same. Expressed in another way as shown in Fig. 2, even though the pH of pure water changes from 7.5 to 5.58 over the temperature range of 0 to 300 C yet the water is neutral over this entire range. Therefore, in discussing the effect of temperature on the reaction of iron and water emphasis should perhaps be placed on the effect of temperature on the rate of chemical reaction between the iron and water rather than upon pH.

Fig. 1. Variation of hydrogen ion concentration and pH with change in temperature for pure water (calculated values)



Feedlines

In general, provided velocities are normal and the pH of the feedwater is within reason (6.0 to 8.5), practically no difficulties are encountered from feedline corrosion. That more difficulty is not encountered is due to the fact that some materials, calcium carbonate for example, precipitates from the water forming a "scale" on the metal. This together with the iron oxide film normally on iron will prevent active corrosion from occurring. If, however, the pH is much lower than 6.0, neither of these films will form and corrosion will result. If the pH cannot be corrected, alloy or rubber lined pipe is often used. No difficulty will result from pH's higher than 8.5 unless brass or copper is present.

Excessive velocity will prevent the formation of either of the films referred to and in addition will cause corrosion, referred to as cavitation-erosion. This type of corrosion involves actual mechanical disintegration of the metal although chemical corrosion may be involved in starting it. An example of the mechanical effect is the tremendous pressure built up when water vapor bubbles, formed in feedwater by "flashing" as a result of high velocity flow, collapse. This pressure has been estimated to be as high as several million pounds per square inch. Under such a condition the metal is disintegrated especially at bends and restrictions in the line.

Feed Pumps

Somewhat the same principles as outlined for feed lines apply. The chief difference is that non-ferrous alloys especially brasses and bronzes are used and turbulence and velocities usually are much higher. The fact that both steel and copper alloys are used in close proximity makes galvanic action possible and the use of copper alloy brings up the question of attack by ammonia.

Very serious failures of feed pumps have been encountered in the past decade. Leaving out the war period when proper metal parts perhaps were not always available or used, the question is often raised as to whether the

This is the second of a series of three articles covering the corrosion of plant equipment by water and steam. The first article dealt with corrosion of boilers; the third one will cover corrosion of steam lines, superheaters and condensate lines.

Peculiarities of corrosion affecting steam lines, feed pumps, heaters and economizers . . . Pure feedwaters cause more corrosion in feed lines than those containing dissolved solids . . . Relative change in pH value with change in temperature of pure water . . . Excessive velocity in feed pipes tends to aggravate corrosion . . . Feed pump failures are result of a combination of chemical and mechanical factors . . . Corrosive factors differ in open and closed type heaters . . . Leakage and galvanic action around economizer handhole caps need careful attention . . . Use of proper material and corrective water treatment are best possible safeguards against corrosion

failures often resulted from chemical corrosion or from cavitation erosion.

From the standpoint of chemical corrosion, pH has been given the most attention. To some extent this is as it should be since the film formed on the metal and therefore the corrosion that takes place is greatly affected by pH. Anything that will affect this film, for example a reducing agent such as sodium sulfite, galvanic action, and dissolved oxygen, should receive full consideration. These factors explain normal corrosion under which equipment will last for years, but they do not explain the very rapid failures.

The very rapid failures, however, that have taken place in some cases cannot be explained only on the basis of some mechanical action. Actually the failures are the result of a combination of chemical and mechanical factors. These combined effects when supplemented by the possible accelerating effect of galvanic action will cause very rapid failure of equipment. The relative effects of these various factors are being investigated by cooperating concerns throughout the country and a better understanding will soon be forthcoming.

Heaters

For the purpose of considering corrosion of heaters, they may be divided as follows:

(1) Open type
  (a) Cascading tray
  (b) Atomizing
(2) Closed type.

The basis of course is that in the open type the steam and water mix or actually came in contact, whereas in the closed type usually water flows through tubes surrounded by steam.

(1) Open type heaters usually involve only iron parts and consequently the usual causes of corrosion of iron prevail. That is, low pH and dissolved oxygen. Corrosion from both causes is of course very severe since both carbon dioxide and dissolved oxygen are liberated in the heaters and there is a probability of local concentration taking place which accelerates corrosion.

(2) Closed type—The tubes are usually made of copper alloy so in addition to low pH and dissolved oxygen there is danger of action of ammonia. There also is danger of "cracking" or mechanical failure of these tubes at high temperatures especially if much ammonia is present.

Perhaps the greatest problem in the case of closed heaters is the deposition of iron corrosion products on the copper alloy tubes. This is aggravated if oil is present. The deposits greatly cut down the efficiency of the heater. They may be removed mechanically by brushing or by chemical cleaning.

Economizers

The problem of internal corrosion of economizers is not as great as with other parts of the feedwater system because:

(1) Much of the carbon dioxide and oxygen have been removed by deaeration before the water reaches the economizer.
(2) What remains has been depleted of oxygen by corrosion elsewhere.
(3) Cast iron parts are often used.

When corrosion does take place since all parts are iron, the usual effects of pH, dissolved oxygen, etc., on the corrosion of iron by water at high temperatures apply. Corrosion is usually worse where the water enters the economizer as dissolved oxygen comes out of solution at this point.

The problem of corrosion around hand hole caps is often troublesome. This is usually due to the fact that some leakage occurs during service and pitting takes place. If these pits are not removed each time by refacing, the leakage becomes worse and bad corrosion will result. Although this is the usual cause of trouble the possible galvanic action between non-ferrous gaskets and the steel or cast iron should not be overlooked.

Prevention of Corrosion

Prevention of corrosion of the types of equipment referred to can be accomplished by two general procedures:

(1) Use of proper materials.
(2) Corrective water treatment.

The latter method is usually followed especially with already installed equipment:

(1) PROPER MATERIALS—When corrosion is encountered, the first thought often is to go to some special alloy that will not corrode. This is usually possible but often not practical. For example, alloys are known from which boiler feed pumps could be made that would last almost indefinitely but the cost would be prohibitive. It is cheaper to replace the pump made out of common materials at intervals. Continuity of service often has a bearing in which case the initial first cost may be justified.

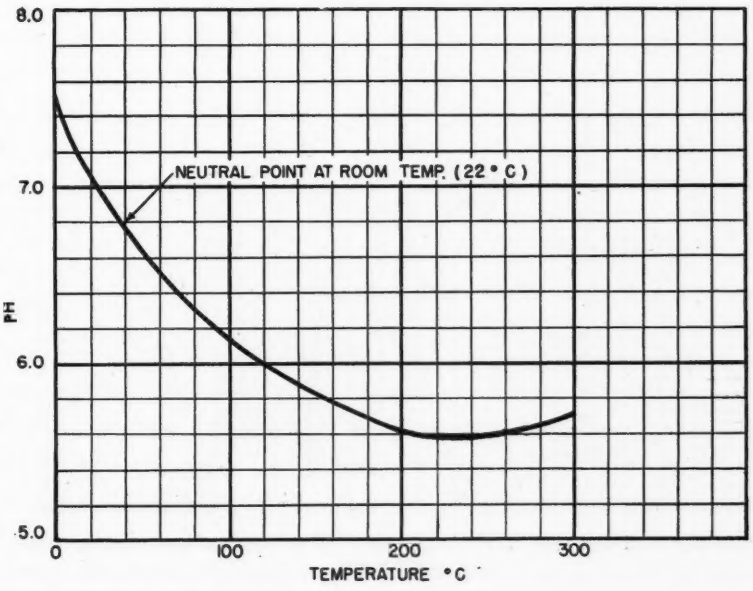
In general, the following table can be used as a guide in the selection of materials for equipment.

pH Range	*Material*
over 8.0	All iron or steel
6.0 to 8.0	Bronze or iron or combination of the two.
3.5 to 6.0	All bronze or, if severe service, corrosion resistant alloy steels.
Below 3.5	Corrosion resistant alloy steels.

This can be no more than a guide inasmuch as mechanical factors as well as chemical ones enter into the picture. What may stand up at pH 6.0 with relatively low velocity or impingement may not stand up at pH 8.0 if the conditions are more severe.

(2) CORRECTIVE WATER TREATMENT—All of the usual means (see Part I), for example deaeration, alikali correction, etc., apply and in many instances

Fig. 2. Change of neutral point of pure water with temperature



are being used satisfactorily. Only the unusual aspects regarding these will be discussed.

(a) DEAERATION—Both cold and hot water deaeration can be used to good advantage. In deciding on how complete deaeration must be, the temperature and scale for tendencies of the water must be taken into consideration. If the water is heated very hot, then the oxygen must be reduced to a very low value, for example below 0.05 ppm. If the water is scale forming, for example by break down of carbonate hardness, then deaeration need not be so complete as the scale will offer some protection.

(b) CORRECTION OF pH—This is effective only in the case of relatively pure waters, that is when a high percentage of condensate is present. Fortunately this is the type of water that usually requires pH correction; impure types usually having a tendency to form scale which is protective.

In order to be effective the alkali must be fed continuously ahead of the affected point. The limitation of this method is that sufficient alkali may be required to raise the pH to a satisfactory value, say 6.5 to 8.0, that excessive concentration may result in the boilers. The method has the advantage, however, that less total solids increase in the boiler will result for a given amount of pH correction than if water that would normally be blown from the boiler is recirculated.

(c) FEEDING SULFITE OR OTHER OXYGEN SCAVENGERS—Oxygen scavengers are often fed into the feedwater system to eliminate oxygen corrosion. They may be effective for a given point of difficulty but since they are reducing agents they may interfere with protective film formation on steel. Corrosion not occurring under oxygen control, therefore, may be aggravated. There has been considerable speculation as to the effect of these materials on feed pump corrosion.

(d) RECIRCULATION OF BOILER OR BLOWDOWN WATER—This method is often used to correct low pH. It is generally applicable only where there is a relatively high percentage of condensate returned, that is when a relatively pure feedwater is used. With this type of water a little alkalli will greatly change the pH; with a more impure water, more would be required and too much would be recirculated causing excessive solids.

Usually only 1 to 2 per cent of the boiler water is recirculated. The amount that need be recirculated is determined by making tests of the feedwater to determine when the proper pH is reached, or if it is desired to know how much will be required ahead of time, the feedwater can be "titrated" with boiler water until the desired pH is reached. If the water is recirculated to the suction of the boiler feed pump no additional pump will be required. If sulfite is used in the boiler and this water is recirculated the sulfite will act as a scavenger for the oxygen in the feedwater.

Problems for Future Consideration

Further information is required on high temperature effects of water especially as to the change of pH with temperature and the significance of pH measured at room temperature to difficulties that may occur at operating pressures where temperatures are hundreds of degrees higher. Also, on the mechanism of certain failures, further data are required involving high temperature, high velocity operation for example in the case of pumps. In this respect the question of chemical corrosion versus cavitation erosion is very important. As mentioned a cooperative test is underway along this line and information soon should be forthcoming.

(To be continued)

1400-F SUPERHEATER BUILT OF HIGH CHROMIUM-NICKEL ALLOYS

SEVERAL of the large plants processing butadiene require considerable process steam at 1400 F, but at relatively low pressure, somewhere in the neighborhood of 50 psi. To supply this steam, high-temperature superheaters have been built by Combustion Engineering Corp. One of these high temperature superheaters as installed in connection with a Type VU steam generating unit is shown herewith, from *Nickel Steel Topics*.

This unit is equipped with a conventional superheater as well as with the high-temperature superheater, the latter functioning independently of the other. Flue gas from the single boiler unit is supplied to both superheaters.

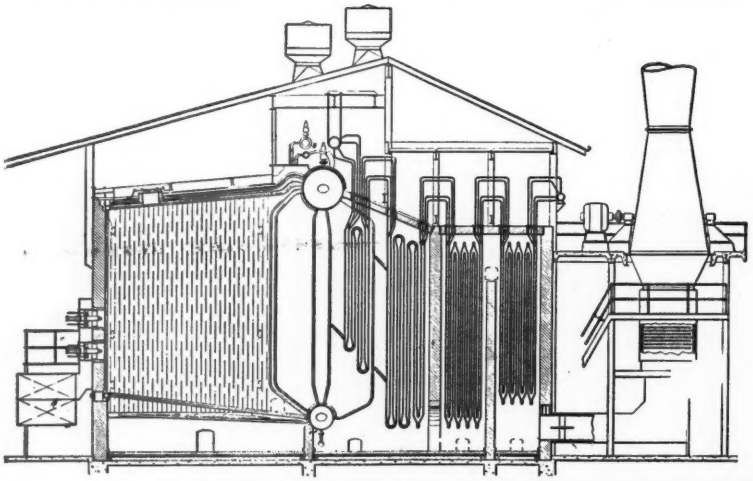
The conventional superheater, on the right hand side of the boiler, provides a total steam temperature of 600 F at full boiler pressure.

The high temperature superheater raises the temperature of 175,000 lb of steam an hour to 1400 F at 50 psi for the butadiene process.

In the high temperature zone the superheater tubes are of "18-8" chromium-nickel stainless steel, as is the outlet header. The tube supports are of higher alloyed material, "25-12" Cr-Ni stainless (Type 309) steel, and the tube spacer castings are of "25-20" (Type 310).

Each of these steam generating units is 73 ft long, 30 ft wide by 30 ft high.

They are commonly operated for long periods of continuous service extending over several months at a time. In spite of the arduousness of these operating conditions, it is stated that the stainless alloys have stood up excellently.



Cross-section through Type VU steam generating unit in butadiene plant showing 1400-F superheater

THE INDUSTRIAL PLANT OF THE FUTURE

By George H. Miehls

IN THIS ARTICLE, on the What Leaders Say page, May, 1946, POWER PLANT ENGINEERING, two corrections should be made. On page 57, column 2, paragraph 3 should begin as follows: "Our investigations have shown that, in general, except in forge plants and foundries where monitors are practically mandatory, and except for the psychological advantage that the monitor type building may provide, the trend is toward the artificially lighted, artificially ventilated plant" and so on.

Also, in the last sentence of the biographical note about Mr. Miehls, bottom righthand corner, page 57, the sentence should begin "The above is a synopsis of views from his recent address" and so on.

The
PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

PIGS REMEMBER

One of our good subscribers, well, I might as well tell you who it is—none other than Bro. Arthur H. Parker of Peterborough Hospital and "Pesky Deer" fame (see P.P.E. Page 115, November 1945) tells me that he has learned something about electric fences that he did not know when we published his stuff about the pesky deer and his vegetable garden. This is, that you do not have to keep electric fences charged all the time. It appears that his cousin has one on his farm, around the pigs and horses. After a pig has put his wet nose against a charged wire he will never again try to find out whether the wire is charged or not. He goes on the assumption that the wire is charged and keeps away from it. The same applies to horses; they learn fast and permanently.

Well, this seems only good "horse" sense or "pig" sense and if human beings were as smart a great many accidents could be avoided, for example, if automobile drivers could only remember that a car running at anything above 40 miles per hour is a source of potential danger, there would be fewer accidents. But they don't remember and so we continue to kill some 25,000 people every year by automobiles. The pig lesson, however, is still a good thing and those who work around power plants and electrical circuits could profit by it. All that is necessary is to remember that a piece of apparatus or a wire or bus bar that once carried an electric charge, may be in that condition at any time and unless you know positively to the contrary, always assume that it is charged. If you will do that you will not run the risk of ventricular fibrillation. If you want to know what that means you can find out by reading an article on Dangerous Electric Currents which we will present in our December issue.

A.W.K.

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A Section of Power Plant Engineering Devoted to
PLANT OPERATION AND MAINTENANCE
Technical Publishing Company
53 West Jackson Blvd., Chicago 4, Ill.

Maintenance of Industrial Electronic Equipment III

Types of resistors . . . Inspecting and tightening resistors . . . Cleaning resistor connections . . . Types of fuses . . . Inpection of fuses and their maintenance . . . Inspection of high voltage insulators and bushings . . . Cleaning, maintenance of bushings, insulators

By WESTINGHOUSE ELECTRONICS COMMITTEE

SEVERAL TYPES of resistors are used in electronic apparatus. The most common type is the wire-wound resistor with an insulating shell of ceramic or high resistance material which has been baked around the resistance element.

A second type of wire-wound resistor frequently used is adjustable or variable. On this type, the ceramic or vitreous enamel coating does not completely enclose the resistance element. One side is exposed and a slider, which is free to move along the exposed portion, is attached. The slider may be clamped securely in place when the desired resistance value is obtained. A third type of resistor is the carbon bodied resistor with an insulating shell.

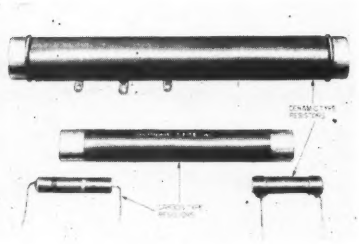


Fig. 3. Typical resistors are shown in this photograph. Top and lower right are ceramic type resistors and the center and lower left resistors are carbon type

The connections to these three types of resistors are either ferrule or pigtail type. The ferrule type consists of metal clips into which the ends of the resistors are inserted. The pigtail type has leads which are easily soldered to make the connection. Work on resistors involves inspecting, tightening and cleaning.

Inspecting Resistors

Do not touch resistors immediately after the power has been shut off as they are usually hot, and severe burns may result. Inspect coating of the ceramic resistors for signs of cracks and chippings—especially at the ends.

Look on the body of all types of resistors for blistering, discoloration and other indications of overheating. (Overheating on a Koolohm resistor can be detected by noticing the dot on its ceramic body. This dot is normally orange. If it is changed to a brown color, the resistor has been overheated.)

Inspect leads, clips and metallic ends of the ferrule type resistors, and all other connections for corrosion, dirt and looseness.

Check all resistor mountings for looseness. Do not attempt to move resistors with pigtail connections because there is danger of breaking the connections at the point where they enter the body of the resistor. Such defects cannot be repaired.

Tightening Resistors

Tighten all resistor connections and mountings whenever they are found loose. If a resistor is allowed to remain loose, vibration may break the connections or damage the body. The tension of the resistor clips can be increased by compressing them with the fingers or a pair of pliers. Using the fingers is preferred.

Cleaning Resistors

Clean dirty or corroded connections of ferrule type resistors using a brush or a cloth dipped in cleaning fluid. If the dirt or corrosion persists, use fine sandpaper such as No. 0000. After cleaning, the ends should be wiped clean with a dry cloth.

Be sure the insulated resistor (such as the large vitreous enameled resistor) is kept clean in order to avoid flashover or leakage between the terminals. Ordinarily, wiping the resistor with a dry cloth will be sufficient; however, if the dirt deposit is unusually hard to remove, use cleaning fluid.

Resistors with discolored bodies cannot be cleaned. Discoloration is indicative of overloading at some time prior to the inspection and is probably due to circuit trouble, which requires analyzing.

Fuses

Both renewable and nonrenewable type fuses may be encountered in electronic apparatus. Included in the renewable element type of fuse are the knife and ferrule cartridge type, while the nonrenewable types are the glass tube fuse (used in fuse clips or bayonet sockets) and the fusetron. Whenever a fuse blows, look for the cause of failure and make correction before installing a new fuse.

The ferrule cartridge type of renewable fuse consists of a body or cartridge of insulating material with a threaded metal cap (ferrule) at each end. Each of the end caps has a screwdriver slot to facilitate its removal during disassembly and tightening during reassembly. To assemble, one end of the fuse element is passed through small slotted washer, as shown in the illustration. Then the fuse element is placed in the cartridge

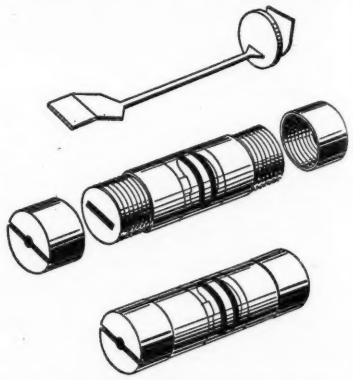


Fig. 4. This drawing shows the method of assembly of ferrule-type fuses

with the washer on one end. The other end is passed through the slot in the closed end of the cartridge. The end of the element is bent over the washer and the cap is screwed on. The other end of the fuse element is pulled tight through the slot in the other end of the cartridge, crimped as before, and the second cap is screwed on.

The knife cartridge type of renewable fuse consists of a fuse element bolted to the knife contacts. This assembly is placed in a body or cartridge of insulating material. To assemble the fuse, replace the metal

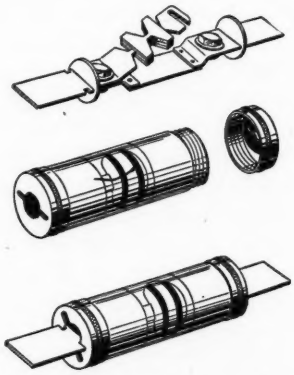


Fig. 5. These fuses are the knife type. Drawing shows the method of assembly

element, bolt it into place, insert the fuse assembly into the cartridge, twist the assembly until it locks into place and replace the metal cap on the end of the cartridge.

The small nonrenewable glass fuses are removed by unscrewing and with-

drawing the cap screws which hold them in place, or by lifting out of fuse clips.

The front of panel type nonrenewable fuse, when removed from the panel, may be removed from the cap screw by simply pulling on the fuse. Care must be exercised to keep the fuse ends and clips clean. When reinserting the fuse, be careful not to screw the fuse in so tightly as to break the connections.

The fusetron is a nonrenewable type fuse which has a definite time lag before it opens. This type provides proper protection from overloads but the fuse will not open because of momentary line surges.

Maintenance of Fuses

Inspect the fuse ends for evidence of overheating and corrosion and fuse clips for dirt and looseness.

Tighten the end caps on replacement fuses, the fuse clips and connections to the clips if necessary. The tension on the fuse clips may be increased by pressing the sides closer together. If necessary, a pair of pliers may be used to adjust the tension.

Clean all fuse ends and fuse clips with No. 0000 sandpaper. Then wipe them with a clean cloth. If it is necessary to use a file to remove deep pits in the fuse clips, fuse ends or contacts, always finish with crocus cloth or fine sandpaper in order to leave a smooth contact surface. Then wipe the surface with a clean cloth.

High-Voltage Bushings and Insulators

Insulating bushings are used in high-voltage circuits to support component parts that must be insulated from ground or where leads must pass through the internal shielding of the apparatus frame. They are constructed of ceramic material with a highly

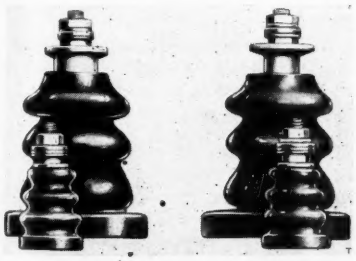


Fig. 6. Typical high voltage insulators are shown in this photograph

glazed surface. An insulator is no better than its surface, so deposits of foreign substances on the surface will materially reduce the insulation value of the bushing. It is, therefore, very important that all bushings used in high-voltage circuits be inspected frequently.

Insulating bushings are used as supports for tube sockets and for high-voltage leads; also, for high-voltage terminals, transformers and capacitors. They are also used as mountings for resistors and high-voltage circuits and as supports for panels which mount other parts. The condition of insulating bushings that are used solely as panel supports is not too critical, but the condition of bushings used as high-voltage insulators is extremely important.

Maintenance of Bushings

Inspect the physical condition of insulating bushings. They should be clean and without cracks or chips. It is possible for a highly glazed insulator to develop fine hairline surface cracks where moisture and dust will accumulate and eventually form a leakage for a high-voltage flashover.

If defective units are found, replace them as soon as possible. As a rule, the bushings are held in position with nuts screwed onto the threaded conductors; while standoff insulators are usually held in place by screws in the threaded portion of the standoff insulator.

If a bushing is used in the mounting for an oil-filled unit, new gaskets should be installed when replacement is made. If replacement is not possible, thoroughly clean the defective bushing with cleaning fluid. Frequent cleaning will be required to prevent flashover.

Tighten all loose bushings and insulators. Avoid forcing nuts too tight. If excessive pressure is exerted on the bushing, damage is almost certain. Gaskets will stand only a small amount of pressure before breaking. If the threads on bushing stud bolts have been stripped, the entire bushing should be replaced.

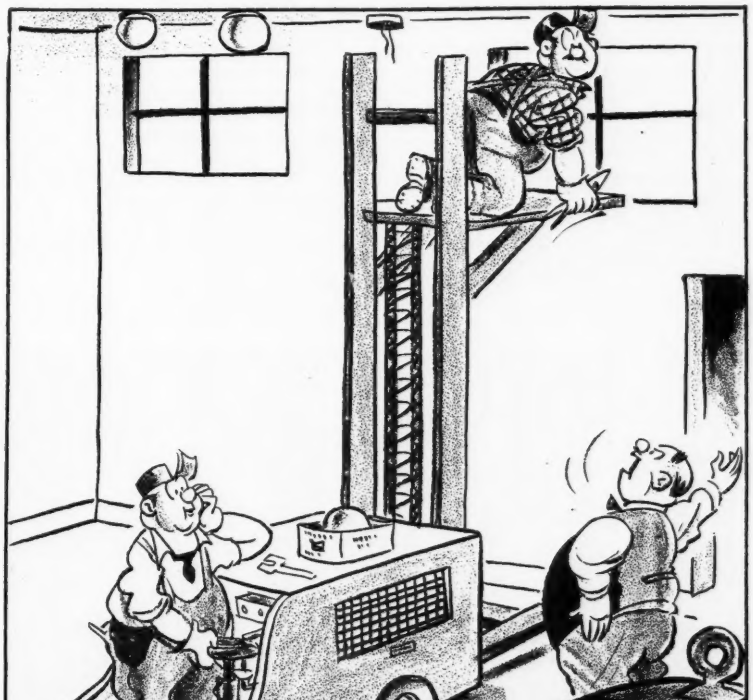
Clean all insulators and bushings with a clean, dry cloth. If deposits of grime or dirt on the surface are hard to remove, cleaning fluid may be used. After the surface has been cleaned with fluid, it should be dried and polished carefully. Otherwise a thin film of fluid will be left, increasing the possibility of high-voltage arcover.

ONE-THIRD OF STEEL MADE SINCE 1937

NEARLY 1,910,000,000 net tons of steel ingots and steel for castings have been produced in the United States from January, 1901, through August, 1946, according to the American Iron and Steel Institute.

Almost one-third of that tonnage has been turned out since January 1, 1938. The one-billionth ton was made in the latter part of 1929.

The two-billionth ton of steel of the Twentieth Century will be produced before 1950. The last quarter of this year should add another 15 to 20 million tons to the above stated total. The steel industry's present annual capacity is around 91,890,500 net tons of ingots and steel for castings.



"It seems that the women in the locker room next door are complaining of a 'peeping Tom'."

Maintenance of Line Shafting

Effects of increasing speed of line shafting . . . Huge property and life losses possible in case of accident . . . Details of inspection procedure . . . What to look for . . . What you may find . . . Method of checking alignment of shaft is shown

By H. J. VANDER EB

Assistant Chief Engineer, Turbine and Engine Division,
The Hartford Steam Boiler and Inspection Co.

DURING THE PERIOD of peak war production the restrictions on materials for new construction and for the replacement of worn-out equipment, plus an acute scarcity of skilled labor, were serious factors affecting the safe operation of line shafting.

Another adverse factor was the practice adopted in many plants of increasing the speed of shafting in order to meet the demand for greater production. Any increase in speed has two marked effects: (1) It imposes a higher rate of bending stress alternations in the shaft material, and (2) It tends to increase the bending stress itself as a result of a greater impact of the forces that cause bending, such as excessive belt tension and unbalance of pulleys and couplings.

As a result of these circumstances there have been many break-downs of line shafts in recent years. One of the worst cases was the breaking of a small idler shaft which led to a flywheel explosion causing a property damage of $50,000 and a use and occupancy loss of $20,000. Another case resulted in a property damage loss of $1300 and a use and occupancy loss of $45,000.

Because of the conditions referred to above, and because of the limited opportunities that have been available for proper attention to maintenance in recent years, there are undoubtedly many shafts that should now be examined carefully for evidences of progressive cracks, misalignment of bearings, insecure bearing supports, overloading and overspeeding.

To make an effective review of line shaft conditions, it is first necessary to observe the shaft in operation under load in order to note any whipping action, loose and vibrating bearing supports or bearings that are loose on rigid supports. Whipping of the shaft between any two bearings may be an indication that the bearings have too much clearance or that the shaft is undergoing a serious bending action as a result of excessive belt tension. Such whipping may also be a symptom of an existing crack which may be concealed by a pulley hub.

Any insecurity of the bearing supports can best be discovered while the line shaft is in operation under load. Frequently it will be found under such conditions that a concrete pier, which supports a line shaft bearing, is broken at its base and is moving with every revolution of the shaft. Where the bearings of a line shaft are supported on structural steel, the amplititude of any excessive vibration should be measured by the use of a vibrometer or by measuring the movement of the structural members with a strain gage.

After observations of the shaft in operation and under load are completed, a careful study should be made of the shaft while it is at rest. Cracks occur frequently next to, or just under, a pulley hub. In the latter case the hub frequently has the apearance of being loose on the shaft. It is particularly necessary to apply a whitewash or a magnetized powder test to any suspected location of a crack. The bolts in any coupling flanges should be examined and tested for tightness. Frequently such bolts are found missing or broken.

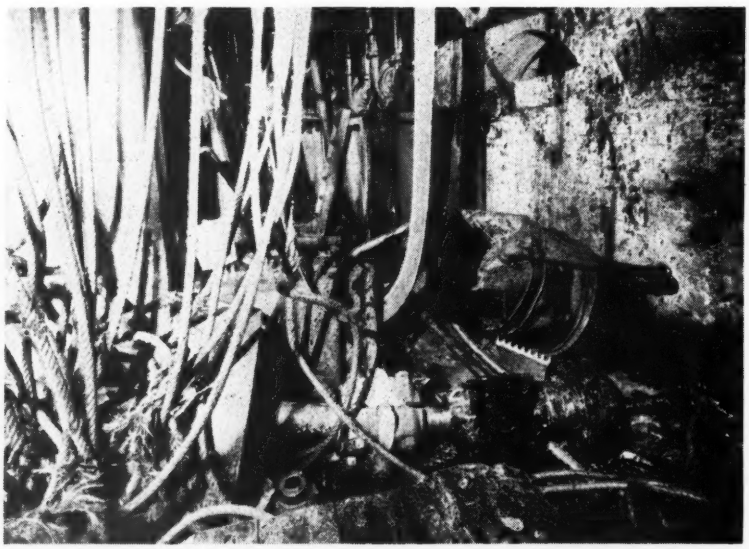


Fig. 1. As a result of this accident, seven sections of shaft together with bearings and pulleys were torn off the concrete piers and eight wheels destroyed. In the foreground may be seen a short section of shaft with the hub of one 62 in. wheel that formed part of the rope drive for the engine

Don't Locate Midway Between Bearings

A typical weakness often found in the layout of line shafting is shown in Fig. 2. In general, neither a pulley nor a coupling should be located midway between spaced bearings, and this is especially true of a pulley that transmits a heavy load and is subjected to heavy initial belt tension. The most desirable location of pulleys and couplings is adjacent to the line shaft bearings as shown in Fig. 3. For a main receiving pulley, which transmits all the load of a prime mover, it is necessary that there be a bearing on either side close to the pulley hub. When improper conditions are found it is important that the spacing of the bearings be corrected or that an additional bearing be installed.

The ideal way to check the alignment of a line shaft is by spanning a steel wire through the center of the bearings or by running such a wire parallel to the shaft. It is also customary to set the bearings of long line shafts initially by means of a transit. For existing installations, however, any of these procedures takes more time than can conveniently be allowed. The method usually followed, therefore, is to make a check of the bearing clearances by means of a feeler gage, and in connection with this procedure the sketch shown in Fig. 4 may be helpful. The heavy line shown in the end view for each bearing (see bottom of sketch) represents the clearance as measured while the belts are on the various pulleys. In the end view shown at the right of the sketch, the direction of the belt tension acting on each bearing is indicated. Any bearing clearance will obviously be on the opposite side of the bearing from the direction of the belt tension.

On the assumption that the bearings are still bolted tightly in their original

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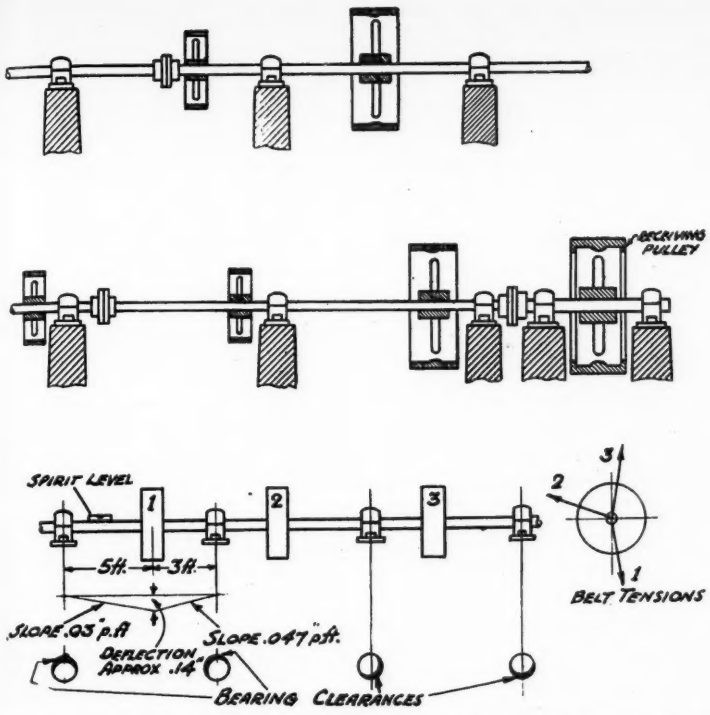

Fig. 2. Top. This sketch shows the wrong location of bearings relative to the pulleys and couplings. Fig. 3. Middle. Correct location of bearings relative to pulleys and couplings. Fig. 4. Bottom. Bearing clearances on the various bearings on the line shafting as shown up when a feeler gage is used

positions on the bearing supports, a careful diagnosis is possible, based on the clearance readings, to determine the approximate location where the highest bending stresses have occurred and where cracks in the shaft can be expected to exist.

As a further aid in determining the probable location of cracks resulting from excessive bending of a shaft that is subject to vertical, or nearly vertical belt tension, a spirit level, preferably at least a 12 in. level, can be applied to the shaft surface, as shown in Fig. 4 for finding the approximate location of maximum deflection.

Babbitt Sometimes Gone

Frequently the wear in the line shaft bearings will be found to have reached such an advanced stage that all of the babbitt on the load side will have worn away. In any case where the bearings are badly worn, they should be readjusted on their supports or, if necessary, they should be rebabbitted or replaced with new ones. When such adjustments or replacements are made, it is advisable that all of the belts be thrown off the pulleys so that it may be determined if the shaft is reasonably free to revolve by hand. Such free movement of the shaft while the belts are off is a fairly good indication that the bearing alignment is satisfactory.

Any binding of the shaft in the bearings should be promptly corrected.

Engineering Progress or World Stagnation—II

Review of engineering conditions in Trans-Jordan, Syria and Palestine . . . Ancient tools, poor lighting, starvation pay of craftsmen in Arabia . . . Antiquated power and pumping equipment . . . Modern Tel-Aviv has up-to-date power station, efficient power and lighting and treated water . . . Modern foundries and machine shops . . . Source of strained relations between Jew and Arab are reviewed

BY FOURTEEN

TO THE NORTH and east of Egypt lies a narrow strip of land that is just as dangerous and explosive as a hundred atomic bombs. Palestine, Trans-Jordan and Syria, very small in area, not heavily populated per square mile, but probably containing more hatred per square foot than any other zone on earth.

Jaffa (ancient name Joppa) with its stinking narrow streets, crowded ancient shops, markets and homes is the Arabic version of a city which has probably changed little since ships landed there with timbers for King Solomon's Temple or Simon Peter had his vision from the roof of Simon the Tanners home. Engineering, as it is known in America, is a total stranger to Jaffa. Visits to numerous machine shops, water pumping stations, and a power station revealed very little modern equipment. For example, a gear blank may be turned out on a 1920 A.D. lathe, the teeth formed with a fly-cutter and the gear finished with a file; or a complete casting or machine part may be completely finished with files while the point is held in a wooden vise. Time seems to mean absolutely nothing to our newly-found neighbors. Many of the establishments manufacturing cast iron products have hand-operated bellows supply air to the cupolas, turning tables or crude lathes operated either by foot or crank and almost devoid of any electrical equipment. On the whole, a majority of the Arabic machine shops are so primitive it strains the imagination of any shop man to conceive the inefficiency caused by dungeon-like rooms, ancient tools, poor supervision, bad eyesight, starvation pay and absolutely no safety or first-aid facilities.

Water pumping stations, power plants and printing offices fare a little better in near modern equipment. Water pumping stations are generally powered by oil or gasoline engines driving reciprocating pumps. Some of the enormous diameters of both the power and liquid cylinders are fantastic in our way of thinking, the speeds seem to be just as drowsy as the Arabic caretakers.

The power stations vary in size from a generator driven by an old tractor engine to units powered by steam engines developing several hundred kilowatts. Printing offices that claim the most ultra-modern German printing presses stand side by side with shops still using wood and linoleum carvings for printing. All this hodge podge is Arabic Jaffa built on the filth of centuries, sullen and defiant, complacent and definitely opposed to modernization or any reforms which will upset their centuries old customs or habits.

Fig. 6. A general pattern of all hammers, used by goldsmiths, blacksmiths, carpenters

Our Arabic neighbors in Palestine and Trans-Jordan are not the same people found in the Valley of the Nile. They are defiant, proud and bound together by blood ties which are hard for peoples of the Western World to understand. An injury to an Arab by a non-believer (anyone not embracing the Koran is considered a non-believer) is considered as a slap

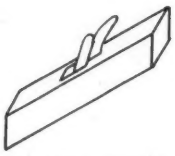

Fig. 7. Wood plane, usually hand fashioned to suit carpenters taste; blades are beaten from any steel that can be hardened

in the face to all Arabs. The working of the Arabic mind is as strange as are their customs. In case of a food shortage in a village, the village leader, usually the man of religion, screams from the minaret, "No village in the world has food." Those words seem to fill the natives' shrunken stomachs, they eat what little food they have, tighten their belly bands and carry on. It is hard to sell people with this type of reasoning a new bridge, a building, a new piece of machinery or new neighbors, especially if the new settlers turn the desert into green, producing community settlements.

Butted against Jaffa is Tel-Aviv, one of the most modern cities in the world, claiming only thirty years of progressive history. It was from desert and waste land that the Jew cleaved this modern metropolis. Within the limits of Tel-Aviv is an up-to-date power station, an efficient system of power and lighting, enormous quantities of treated water, modern foundries and machine shops, and numerous engineering and architectural establishments.

Tel-Aviv needs little or no detailed description for any modern section of our American towns is a prototype of this leading Middle Eastern city. The modern section of Haifa, Jeru-

Fig. 8. Moses watched grain being threshed with the same type of flail the natives beat out their staff of life with today

salem, and many of the Jewish community settlements depict our own standards of modernization, but they are invariably surrounded by the backward villages of Arabs.

There are several outstanding establishments in Palestine which deserve a short discussion. A point of special interest was a small electrical appliance and instrument manufacturing plant. It was operated by two European-educated Jews of outstanding ability. A short trip through their display section proved they were capable of manufacturing almost any type of appliance or instrument. The shortage of small gauge copper wire handicapped them only a short time for they designed and built a broaching machine which would turn out any gauge wire needed. Practically every machine in the shop was built within the shop.

Another extreme case of efficiency was a foundry and machine shop operated by an English Jew; he had started out with a toothpick, needle and piece of string and had eventually fashioned two large cast iron cupolas, an excellent pattern shop and a machine shop capable of turning out almost any piece of machine work required by up-to-date demands. If a new lathe was needed the cast iron parts were cast, aged and finished under one roof, other essential parts were formed in the same shop—final results: a new lathe.

Other shops of equal efficiency were observed, including a diamond cut-

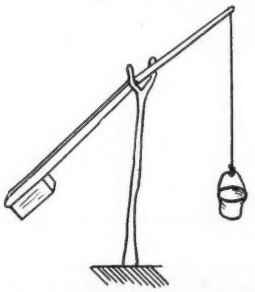

Fig. 9. One of the most popular water lifts for irrigation; probably because the operators can sit down or even recline while raising water

ting shop, optical and camera factory (part of this graciously built by the U. S. Government) several excellent machine shops, a modern petroleum refinery, railroad shops, and numerous establishments essential to modern progress.

A strained situation is created by the fact some Arabs have installed power machinery. Inasmuch as Arabic facilities are seldom if ever available to make major repairs on the equipment the Arab is forced by circumstance to either junk the equipment or deal with his Semitic brother. This is distasteful to both parties.

The refugee and Middle Eastern Jew has proven, by his accomplishments, that he is progressive. The influx of European Jews has filled the manpower reservoir to overflowing with highly skilled craftsmen and professional men yet the future will lead to zero unless the age old hatred between the Arab and Jew is settled, quickly and completely. To exist, the Jews must expand both industrially and agriculturally. This means encroaching on lands already jealously guarded by the Arabs.

Palestine presents one of the most complex problems in the world. Within that small area there are two branches of one race and nowhere is the hatred more burning. Several hundred Jews and Arabs have worked together in Army shops yet every hour of the day exposed the deep-

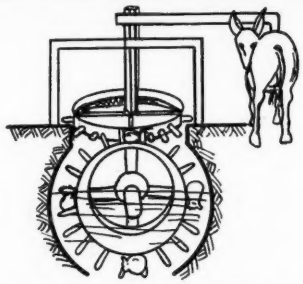

Fig. 10. A water wheel powered by camel, water buffalo, woman or any other Middle Eastern beast of burden. Although several thousand years old it is the nearest piece of machinery to application of more than one engineering fundamental

seated dislikes. The tension could be felt on every turn, yet the American soldier kept production rolling from the shops.

Modern fast transportation has given us some strange next door neighbors: Alexandria, Egypt, a city of progress, beautiful and old . . . Memphis, Egypt, glorious only in name . . . Jerusalem, old as the hills, yet surrounded by new developments . . . Haifa, built on ground known to the oldest Christian yet progressive and modernized . . . Tel-Aviv and Jaffa, the newest with the oldest, both standing on blood saturated ground.

Just what contributions modern engineering will play in the future of the Middle East is a question which may not be settled for years. Our neighbors are direct opposites in characteristics; one desiring everything progressive, the other just wanting to be left alone with his coffee and rest.

Engineering achievements in communications, transportation and aviation has given us some strange neighbors whom we cannot and dare not ignore. We are indubitably tied to the masses of the other nations, whether we like it or not. Although it may take a little longer for the effects to reach us, events in the Middle East influence our daily routines and future just as much as if they had taken place in New York or San Francisco.

World politics and diplomacy will decide the course for economic stability but it remains the problem of all branches of engineering and engineers to bridge the gap between 1 A.D. and 1946.

WE ARE ALL familiar with static electricity which causes sparks to jump from charged objects. In industry, this occurrence may be hazardous. A modern solution to this old problem is a static eliminator which uses a radioactive salt that emits alpha rays. These rays ionize the atmosphere sufficiently to allow dissipation of the static charge.

Preparing A Steam Generator For Service

Few engineers who have not been present during the process of putting a large steam generator into service can realize how many details are involved, how carefully every piece of auxiliary equipment has to be tested and finally how all the many parts have to be coordinated so as to make the unit one great workable whole. It is a very complicated and painstaking process and if it is not done correctly great damage can be done to extremely valuable equipment. In this article the author tells exactly how a large unit is prepared for service and he does it in a way so that you actually live it. Some of you who read this article may recall another article by Mr. Gore, one entitled "Making Steam is a Complex Business" in the June issue of this year. In that article he analyzed the whole process of making steam and in doing so brought out many facts that are ordinarily lost sight of. Mr. Gore is not only an experienced engineer but he has a philosophical turn of mind which enables him to make the reader almost live the process he describes

By JOHN C. GORE

SPRINGING from a mud hole the new power plant now rises a thing of beauty as erection nears completion. Dirt, noise, haste, and at times confusion, mingle with the perspiration of men's bodies and the sound of rough voices have all blended in the process of creation. Vision, careful planning, experience and skill have been added as fermenting factors and from this mixture a new plant has grown, taking shape, the results of many men's labors. Slowly through the long months a fixed pattern has been developed until the original image created in the minds of men, months or even years before, now stands nearly completed.

To the men building, days of hard labor have multiplied until there seems to be no end to their tasks and the end to their labor seems far in the distant future. And then suddenly a new factor is added to their daily conversation and the realization is born that the work nears completion. Word passes from group to group and from man to man that somehow, somewhere a decision has been reached. The starting-up date for the new plant has been established. Discussion of the news leads to some arguments. Some say that it will be impossible to complete all of the remaining necessary work in the time allowed. Bets are made and the estimates of the actual starting-up date range far into the future with few wagers upholding the judgment of the men who have established the starting-up date. The old time erectors do not argue but simply shrug their shoulders and say, "Time alone will tell. We have our work to do so let's get on the job." With this admonition the men quietly begin their tasks as each worker realizes that the final date for starting up is not as dependent on their individual ideas as on the time required to complete their work. The new factor of a fixed starting date makes its presence felt. The work now proceeds at an accelerated pace that is surprising to even the most experienced workers. Jobs which once seemed endless are suddenly found to be finished. The new factor of having the end of the job in sight in itself seems to be a magic something that gives purpose to the workers efforts, and each man tries to finish his allotted work as quickly as possible so that his part may be complete before the established starting-up date.

The First Pump is Given a Trial Run

As the work nears completion the day arrives when a new unaccustomed noise is heard and word quickly travels from the lower to the upper levels that one of the new pumps in the basement is being given a trial run. The operating crew is slowly assembled, and as these men gather the testing of equipment proceeds rapidly. Unusual noises become a common occurrence and it is as though a slumbering giant is awakening from a deep sleep as the new plant slowly comes to life. The whine and high pitched noises of the fans being tested, the low rumble of the pulverizers as they are checked all blend into a medley of voices proclaiming the approaching starting-up date.

Manufacturers representatives, service engineers and the operating crew are now on the job and the process of testing each piece of auxiliary equipment proceeds at a rapid rate. Strangers are seen crawling over the larger units checking and inspecting the equipment and construction with critical eyes. Certain alterations, corrections and last minute changes are added to the erecting crews' work lists for completion before the unit is placed in actual operation in order to avoid future operating troubles. Pipe lines are checked for dirt and other obstructions and are cleaned. Bearing troubles, sticking dampers, improper expansion seals, obstructions to free expansion of various parts, and innumerable other sources of trouble are found and eliminated. The erection crews work long hours making the suggested changes and some of the men grumble and mutter that the work will never be completed in a manner satisfactory to the service engineers. Men with small notebooks are checking and recording control and damper settings while talking a strange language which the erection crews gather is largely concerned with the phrases: rate of travel, inches of travel per pound of pressure and sensitivity. Governor mechanisms are a source of endless worry to the turbine men while the electrical crews are recording data in mysterious terms of; megohms, amps, and other queer sounding names. The erection crews assist the service engineers with the installation of testing equipment and are puzzled to understand the purpose of thermocouples, thermocouple boards, potentiometer boxes, gas sampling tubes, pitot tubes, steam nozzles, fly ash collectors, vibrometers, wattmeters, orsats and various other items which are installed and made ready for use.

The erection crews through such contacts, are becoming familiar with the service and operating engineers and are finding that these men speak and know their language. The same jokes and stories become common to both groups and a spirit of close cooperation develops between the groups as they realize that their objective, namely to get the equipment into condition for initial operation, is the same. Several old friendships betwen the more experienced erectors and service engineers are renewed as these men have been together on jobs at other new plants and in such cases some spirited disagreements are likely to occur during an evening's entertainment when the value of five cards in a poker hand is discussed. In general however, the work proceeds smoothly and rapidly to its final ending.

Drying Out the Boiler

Again the latest bit of news is published on the chatterbox newspaper, each man receiving his copy from the lips of another. The news flash is as follows: A fire is to be started in the new boiler in the next few days. No, it will not be

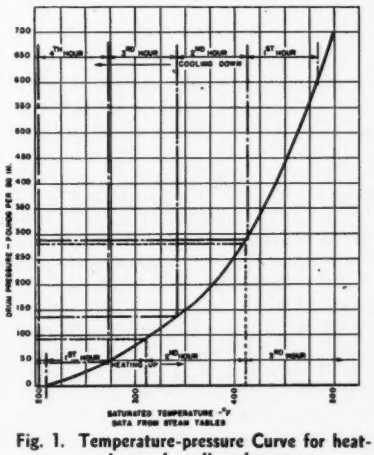

Fig. 1. Temperature-pressure Curve for heating and cooling down

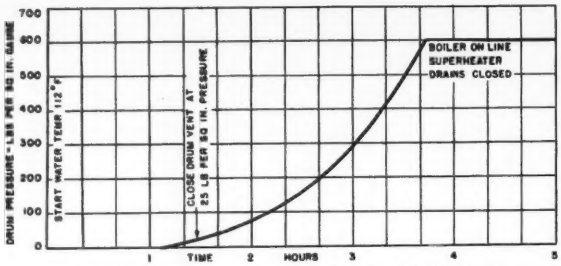
DRUM PRESSURE - LBS PER SQ IN. GAUGE
START WATER TEMP 112°F
CLOSE DRUM VENT AT 25 LB PER SQ IN. PRESSURE
BOILER ON LINE SUPERHEATER DRAINS CLOSED
TIME
HOURS

Fig. 2 (a). Temperature-Pressure limitations during heating up.

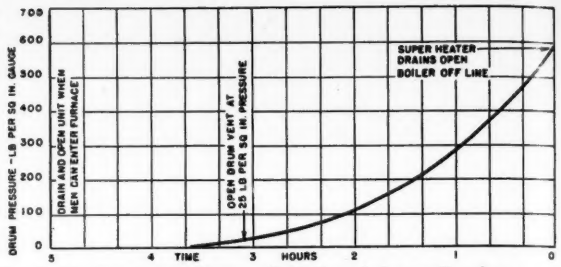
DRUM PRESSURE - LB PER SQ IN. GAUGE
DRAIN AND OPEN UNIT WHEN MEN CAN ENTER FURNACE
OPEN DRUM VENT AT 25 LB PER SQ IN. PRESSURE
SUPER HEATER DRAINS OPEN BOILER OFF LINE
TIME
HOURS

Fig. 2 (b). Temperature-Pressure limitations during cooling down

for the purpose of making steam but it will be a small fire for the purpose of drying and boiling out the unit. The oil burners which are to serve as auxiliary burners for burning oil as well as lighters for the pulverized coal, will be used during this period as extremely low rates of firing can be maintained without burner ignition trouble which would occur if the pulverized coal burners were used at minimum firing rates. By using the oil burners at extremely low firing rates the setting can be gradually warmed up and the brickwork and insulation can be dried out slowly avoiding any excessive shrinkage cracking of these materials. If the pulverizers were to be used at minimum firing rates. heat would be added to the setting too rapidly causing a variation of temperatures in the refractories and insulation and driving off the moisture too quickly to avoid excessive shrinkage cracking and damage to the materials. The boiling out is to be combined with the drying out procedure in order to save time and to complete both procedures with one firing period. The small drying out fires will be maintained for 48 hours and the firing rate will then be increased for the boiling out period. The fires will be gradually increased until the unit is steaming and under pressure thus establishing circulation of the mixture of water and boiling out chemicals through every part of the unit. The boiling out period will continue for an additional 24 hours after increasing the firing rate so that the chemicals will have sufficient time to loosen or dissolve all dirt, oil and mill scale on the inside metal surfaces, leaving them clean for good heat transfer characteristics during operation.

Cleaning the Boiler and Testing It Hydrostatically

Preparation for the boiling and drying out fires are completed in the next few days. The erection crews assist and watch each move with interest. and special editions on the chatterbox news keep all of the men informed and up to date on the progress being made. (Talk about a bunch of old women?). The boiler unit is cleaned internally, each drum and header being carefully brushed to remove all loose dirt and foreign materials. The flue gas passages through the superheater, boiler, economizer, air heater, dust collector and ducts are carefully inspected and all loose construction material is removed. Wood. paper and other combustible trash are removed in order to eliminate possible flame sources which might ignite combustible, staganant gas bodies which often collect as a result of improper combusiton at low firing rates in a large furnace. The ignition of such gas bodies can be exremely dangerous and destructive as the resultant explosion on ignition can be very violent. The boiler unit, after it has been inspected and cleaned, is filled with boiler feedwater, care being taken to maintain water temperatures within plus or minus 50 F of the drum metal temperature. Higher or lower temperatures of the entering water would cause unequal temperatures in the metal parts with resultant unequal expansion changes and stressing of the metal parts. During the boiler filling period a careful inspection is maintained to detect leaking hand hole caps, drum manhole leaks and possible tube seat leakage. Slowly the unit is filled, and water finally emerges from the top drum vent indicating that the unit is full of water and that all air has been forced from the unit. Economizer superheater and drum vents are closed as each spouts water indicating that the units are full of water. A man stationed on the blowdown valves, checks to make sure that all valves are closed and stands by to open a valve on signal if the pressure should become too high, since the pumps are still running. The pump is allowed to continue pumping until the pressure in the unit is 1½ times the maximum working pressure and the unit is thus tested for leakage hydrostatically. The leakage is found after another visual inspection and the pressure is maintained with only a slight drop after the pump is shut down, indicating that no unobserved leaks are present.

After allowing the unit to stand under pressure for some minutes the signal is given that that test has been satisfactory. Blow off valves are slowly opened and the pressure is allowed to drop. Drum vents are opened and the superheater is drained. When the pressure is all off the unit the water level is lowered until it is below the top drum manholes. The top drum manholes are then opened for addition of the boiling out chemicals, as the feedwater treating pumps are not ready for service and cannot be used for pumping chemicals into the top drum. The chemicals are carefullly weighed and dissolved and the resulting solutions are poured into the top drum, under the supervision of the plant chemist. He has calculated the amount of each chemical to be used on the basis of the total water in the boiler unit and the following concentrations and chemicals are used to dissolve and to hold in solution or suspension, all grease, dirt and loose mill scale so it can be blown from the boiler during the boiling out period:

Trisodium Phosphate ...2600 ppm.
Sodium Metasilicate ... 800 ppm.
Caustic Soda ..... 125 ppm.

The work of mixing and adding chemicals requires some time and the men assisting in this task are kidded about being poor cooks and remarks are made about the possibility of using their experience in mixing drinks behind Joe's bar. Finally the chemicals are all dissolved and poured into the drum. The pump is started and the water level in the top drum is slowly raised until it is just below the top manhole opening. The water gages are then opened and allowed to fill, and the service engineer very carefully checks the actual water level in the drum with that of the gage glasses. Satisfied that the gage glasses are showing the true water level. he orders the top manheads replaced and the water level is adjusted so that it is barely visible in the bottom of the water column or gage glass. Other men have been busy removing the blank flanges used on the safety valve connections and the drum and superheater safety valves are installed and in place. Drum vents, superheater drains and economizer recirculating lines are opened wide and men again check to make sure that the water column lines are free and that the connecting valves are open. Water column drains are opened and closed to check that no piping obstructions exist. The men who have been assigned to tend the fires make their final preparations before lighting off. The entire boiler setting is checked and all access doors are closed and all

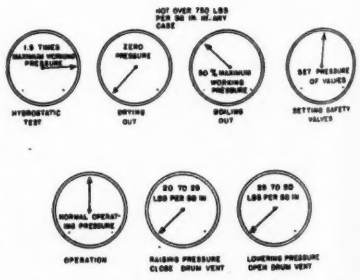

Fig. 3. Important boiler gage readings during period of preparation for service

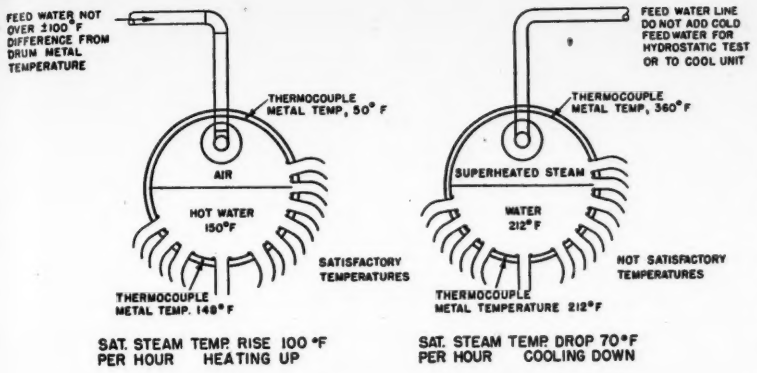
FEED WATER NOT OVER ±100° F DIFFERENCE FROM DRUM METAL TEMPERATURE
THERMOCOUPLE METAL TEMP, 50° F
AIR
HOT WATER 150°F
SATISFACTORY TEMPERATURES
THERMOCOUPLE METAL TEMP. 140° F
SAT. STEAM TEMP. RISE 100 °F PER HOUR HEATING UP
FEED WATER LINE DO NOT ADD COLD FEEDWATER FOR HYDROSTATIC TEST OR TO COOL UNIT
THERMOCOUPLE METAL TEMP, 360° F
SUPERHEATED STEAM
WATER 212° F
NOT SATISFACTORY TEMPERATURES
THERMOCOUPLE METAL TEMPERATURE 212°F
SAT. STEAM TEMP. DROP 70°F PER HOUR COOLING DOWN

Fig. 4. Drum temperature limitations

HEATING UP. Heavy drums over 3½ in. shell thickness metal temperature differences should not exceed 100 F when heating up. For extra heavy drums the temperature rise in the metal can be controlled by flooding drums during period before steam is formed. When water temperature is below 212 F after steam is formed the limitation of increasing steam temperatures 100 degrees F per hour will prevent drum metal temperature difference from exceeding 100 F. Flooding can be discontinued when top of drum reaches a metal temperature of 115 F. Flooding should be done when fires are out. If hot water is not available raise temperature of water in drum to 130-140 F by firing unit, then put fires out and flood drum. When top and bottom drum metal temperatures reach 115 F lower water level to normal and bring unit up in normal manner observing saturated steam temperature limitation to 100 degree F rise per hour

COOLING DOWN. Heavy drums over 3½ in. shell thickness metal temperature differences should not exceed 70 F when cooling down. Before putting out fires allow pressure to drop until top of drum is slightly hotter than bottom (not over 50 F) then put fires out and raise water level slowly using hot feedwater. When drum is flooded top thermocouple temperature will drop. Keep drum flooded by adding water as shrinkage takes place. Top drum thermocouple will show higher temperature than bottom if shrinkage allows steam to form. Do not allow temperature difference between top and bottom thermocouple to exceed 50 F. Do not flood superheater but keep vent open. Cool down boiler unit slowly dropping saturated steam temperature 70 degrees F per hour. This temperature limitation is lower than that permitted when starting up as stress due to pressure must be added to stresses in drum when cooling down. When all pressure is off unit a hydrostatic test can be applied. Unit can be drained when it is cool enough for men to enter furnace or when tubes are cool enough to lay a bare hand on their surface

dampers are placed in the closed position.

Slowly the men assemble on the operating floor, their duties complete. Men are assigned to various locations, some to watch the fans and others to check pumps and oil handling equipment. Suddenly the quiet is broken by the high pitched wail of the induced draft fan starting as the operator swings into action. The furnace draft or uptake damper is adjusted from the operating board to give a slight negative draft on the furnace. Again a new sound is heard as the forced draft fan is started and again dampers are adjusted by hand to give the proper windbox pressures and to maintain the furnace draft at a negative valve.

All by-pass dampers are opened slightly in some cases by men going directly to the damper locations and fixing the damper positions by hand if controls are not available. The operator slowly increases air flow through the unit until he is confident that the air flow exceeds 25 per cent of the maximum for the unit in actual operation. This high air flow is maintained for 5 minutes to sweep or purge any stagnant gas bodies from the unit before lighting the fires. At the end of 5 minutes the operator closes all burner box dampers and then adjusts the air flow to give approximately 0.4 in. furnace draft and the correct windbox pressure. A burner is selected for lighting off and an oil burner with a small sprayer plate in the tip is inserted into the burner and connected up to the oil supply system which has been brought up to temperature by recirculation of oil from the heater for the past hour or longer. The burner windbox dampers are cracked open.

Atomizing steam is turned into the burner and then a hand light-off torch is lit and inserted in front of the oil burner. The oil is turned on and a rich golden flame blossoms forth in front of the burner. The operator quickly adjusts furnace draft to prevent a positive pressure in the furnace and the oil pressure to the burner is rapidly increased to the minimum specified for the burner in order to insure proper atomization of the oil. Furnace drafts are then adjusted to give from — 0.1 to — 0.2 in. of water. The service engineer peers into the furnace observing the flame for fire-flies or small globules of flaming oil which would indicate improper atomization or too high excess air. He reduces the air flow by closing the burner damper and again spends some minutes in observation of the flame. The flame now has a dark smoky fringe and he again adjusts the burner damper, opening it to give it slightly more air. Finally, satisfied that the flame is burning properly, he leaves the building to observe the stack and finds a light gray haze rising lazily into the air which further satisfies him that combustion is satisfactory and that no oil deposits will condense on the cool metal surfaces of the boiler, superheater, economizer or air heater which might be dangerous. Such deposits which often occur due to improper combustion, and the presence of unburned oil in the flue gas, can cause explosions or serious fires in the back passes of the unit as the firing rates and temperatures are increased.

The potentiometer thermocouple installation has been placed in service, and gas and metal temperatures are being checked and recorded for the superheater section. Gas temperatures entering the superheater are arbitrarily established at a maximum of 700 F for the drying out period and the firing procedure and rate is established by these temperature readings. When temperatures become too high, the oil burner is put out and the unit is allowed to soak up the heat for from 5 to 20 minutes without any fire being present and with dampers closed to reduce air flow. When gas temperatures have dropped, the oil burner is again lighted and this intermittent method of firing is continued for the 48 hour drying out period. Gas temperature bulbs are checked and adjusted and the recorders are then used for maintaining permanent records of the gas temperatures through the various boiler and economizer sections, during the balance of the drying and boiling out periods. The service engineers check thermocouple readings less frequently after the initial service of the temperature recorders as these can be used to maintain the proper firing rates. Infrequent checks are made of gas and metal temperatures through the superheater section to correlate and check this data with the temperature records being secured as temperature recorders have been known to slip out of adjustment or to have leaking gas elements which give wrong readings. Superheater temperatures are important as no cooling water is inside the tubes and the possibility of overheating the metal is therefore increased. Slowly the unit begins to heat up but at the end of the second day the tubes are still not too warm to lay a bare hand on the metal surfaces.

With the 48 hour drying out period now complete, the firing rate is slowly increased, being limited only by tube metal temperatures in the superheater which is established at a maximum of 900 F. Oil pressure to the oil burner is increased and the firing now becomes a continuous procedure. All changes in firing rate are made by varying oil pressures to the burner. A definite swell or raising of the water level in the drum, is noticed in the water column.. The tubes in the boiler are now getting too hot to place a bare hand on them and the circulators outside of the setting are getting warm indicating that circulation has been established. The new unit is coming to life and vapor bubbles and steam are being produced in the tubes even though no pressure rise is noted on the drum pressure gage.

The Boiler Comes to Life

Softly, lazily, the unit comes to life as the firing rate increases. The open drum vent shows a plume of white vapor and in a few minutes this vent begins to sputter and hiss as steam is released. The smell of hot metal, drying insulation and burning paint permeate the building and the air seems to be charged with a feeling of expectancy. The first faint sounds of escaping steam

turns into a steady impatient noise as the steam tries to escape from the drum and soon additional wisps of steam are seen emerging from the open superheater drains. A light tapping, impatient operator's hand now urges the pressure gage pointer to leave the pin and the new unit is under pressure. The pressure slowly increases and at 25 psi the service engineer, as though tired of the annoying sound of the roaring drum vents, goes up and closes the valves on the vents. The superheater drains which have been piped out of the building continue to blow muffled vents on the roof but inside all is comparatively quiet and the men give a sigh of relief as the unit seems to settle down quietly to the job of increasing steam pressures. The initial blowing of the drum vent has freed the steam space of all air and other non-condensable gases and steam is now flowing through the superheater tubes providing a cooling medium to prevent the metal from overheating. Gas temperatures through the superheater are still maintained at a maximum of 900 F.

The group of service engineers and operators are now busy at innumerable tasks. Careful inspections of expansion joints on the casing and clearances for other moving parts are made and any obstructions to free movement are eliminated. Handhole plates and drum manheads are examined for leaks and men are busy tightening up on the bolts to keep all such joints from leaking as the unit heats up. Water columns are slowly and carefully blown down at predetermined pressures which correspond to a given steam temperature rise of 50 F. This brings the gage glass up to the temperature of the steam and prevents uneven heating in the water column which is likely to result in a shattered glass. The service engineer carefully watches firing rates and limits the increase in drum pressure so that the steam temperature rise does not exceed 100 F per hour. As the pressure increases the water level rises in the top drum until it is near the top of the water column. The unit is then blown down and the water level is lowered approximately one half the total length of the glass, or, in boiler room language, half a gage is blown down. This amount of blowdown is divided evenly between the various drum and header blowdown valves and assures that any dirt or sludge collecting in these areas is removed by the outrushing steam and water. Blowdown schedules are established on an 8 hour basis and this procedure is repeated as the boiling out period continues. Water is pumped to the unit as required to maintain a normal water level at the center of the gage glass and to make up for losses from the superheater drains and from the blowdown operations.

The pressure gage creeps upward until it is 50 per cent of the maximum operating pressure (not over 750 psi in any case), and the fires are regulated to hold this pressure for the balance of the 24 hour boiling out period. The plant chemist is busy checking boiler water concentrations and examining the blowdown samples for sediment. The next day as the boiling out period draws to a close he orders that the frequency of the blowdown periods be increased, and as fresh water is added to make up for the blowdown loss the solids concentrations in the boiler water are decreased. When these concentrations have been lowered to those specified for normal boiler operation, the firing rate is increased and the steam pressure is slowly brought up to the specified operating pressure of the unit. The service engineers now go on top of the unit and lift the safety valves manually so as to blow the vent piping clear and to remove any dirt from the valve seats, which would damage these valves if they chattered in actual operation. The erection crews are startled by the sudden unexpected sound of steam roaring up the vents but they now understand why the service engineers were so careful in checking these vents for possible obstructions and proper supports. Men have been badly hurt by vent piping which has torn loose under such a test and obstructions to the free flow of steam can result in fatal burns to men working in restricted quarters near the valve connections to such piping. Finally satisfied, the service engineers adjust the gags or hold-down clamps on all but one safety valve and then signal to the operator to take the pressure on up so that the one safety valve will open automatically. The work of checking and setting pressure valves continues and each valve is blown several times before the service engineer is satisfied that the settings and the reading which he so carefully recorded are correct. Some valves are found to have the correct settings while others require considerable adjustment to bring them into range. The superheater safety valve is the last one checked and this valve sounds like a piece of light artillery when it goes off. Finally the service engineer secures the proper setting and as he removes the gags and goes below to the operating floor, a sweaty, hot figure, the erection crews working in areas above the unit heave a sigh of relief to be rid of him and his startling noises and the nerve-wracking vibration of the safety valve vents.

Blowing Out the Main Steam Piping

The erection crews soon find out that the strange noises for the day are not over. Plans have been made to blow out the main steam piping to the new turbine. The by-passes around the non-return and other valves have been opened, bleeding steam into this line to heat it up. The drains are all open to remove condensate or water from low points in this line and to assure complete circulation of steam to all sections of the line. The line is carefully checked for expansion clearances and for the proper supports. Finally the non-return

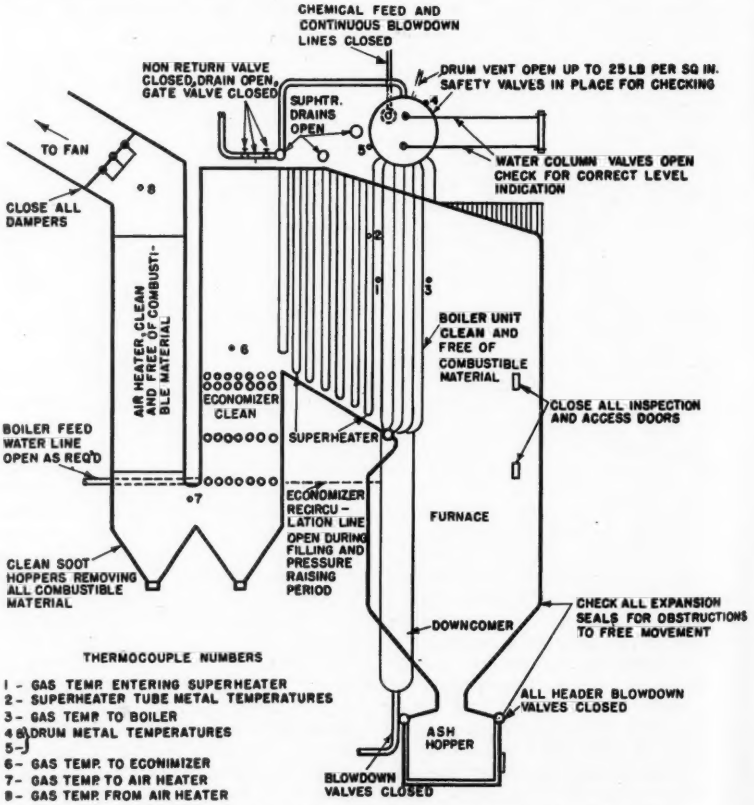
CHEMICAL FEED AND CONTINUOUS BLOWDOWN LINES CLOSED
NON RETURN VALVE CLOSED, DRAIN OPEN, GATE VALVE CLOSED
DRUM VENT OPEN UP TO 25 LB PER SQ IN. SAFETY VALVES IN PLACE FOR CHECKING
SUPHTR. DRAINS OPEN
TO FAN
WATER COLUMN VALVES OPEN CHECK FOR CORRECT LEVEL INDICATION
CLOSE ALL DAMPERS
AIR HEATER, CLEAN AND FREE OF COMBUSTIBLE MATERIAL
BOILER UNIT CLEAN AND FREE OF COMBUSTIBLE MATERIAL
CLOSE ALL INSPECTION AND ACCESS DOORS
ECONOMIZER CLEAN
SUPERHEATER
BOILER FEED WATER LINE OPEN AS REQ'D
ECONOMIZER RECIRCULATION LINE OPEN DURING FILLING AND PRESSURE RAISING PERIOD
FURNACE
CLEAN SOOT HOPPERS REMOVING ALL COMBUSTIBLE MATERIAL
CHECK ALL EXPANSION SEALS FOR OBSTRUCTIONS TO FREE MOVEMENT
DOWNCOMER
THERMOCOUPLE NUMBERS
1 - GAS TEMP. ENTERING SUPERHEATER
2 - SUPERHEATER TUBE METAL TEMPERATURES
3 - GAS TEMP. TO BOILER
4 & 5 - DRUM METAL TEMPERATURES
6 - GAS TEMP. TO ECONIMIZER
7 - GAS TEMP. TO AIR HEATER
8 - GAS TEMP. FROM AIR HEATER
ALL HEADER BLOWDOWN VALVES CLOSED
ASH HOPPER
BLOWDOWN VALVES CLOSED

Fig. 5. Important items to be checked before starting. Drying and boiling out. Fire in boiler unit

valve is opened part way and the boiler operators are warned that the line is to be blown clear and that they should watch their water level and steam pressure drop. The steam line in the turbine room has been disconnected from the turbine inlet and a temporary pipe has been arranged to blow the steam out an open doorway. Observers and curious erection personnel gather in the turbine room as men prepare to open the last gate valve in the line. A signal is given and a soft rushing sound is heard by the observers in the turbine room. Suddenly a gushing jet of dirty black water and steam emerges from the pipe and with a loud startling roar, steam blows for many feet out of the end of the pipe. The jet action of the steam leaving the pipe causes the end to whip and many observers will claim it jumped unheard of distances, but the engineers anticipating such a reaction, have the pipe securely anchored, because from experience they know that without such supports the pipe would have whipped loose and like a huge threshing snake it would have smashed and wrecked any equipment in its way. Even the old timers are startled by the roar and vibration in the air, caused by this huge expanding jet. Light fixtures high on the turbine room ceiling swing crazily and one smashes against the ceiling and parts come cascading down. The pressure waves traveling from the jet are causing a serious disturbance in the air in the turbine room which the engineers had overlooked. A quick signal is given and the men on the huge gate valve close this valve before further damage can be done. A quick consultation between the engineers is held and a decision is reached that the blowing out of the line should be completed even though a few light fixtures are broken. Again steam is admitted to the line and again it is shut off and this procedure is repeated until the engineers are finally satisfied that the new steam piping is clean and free of dirt and solid particles.

Cooling the Boiler

The valves on the steam piping are finally all closed with the exception of all drain valves which are opened wide to eliminate condensation from the line as it cools. The boiler operators are notified that the line is clean and that their fires may be put out after their water level adjustments are complete. As the fires go out, men scurry up the the stairs to the superheater drains and close them to prevent too rapid a loss of steam pressure which would drop the temperature too quickly. As there is no hurry to cool the boiler unit down, the fans are shut off in a few minutes and then all dampers are closed. The unit, thus bottled up, may hold heat for several days making it impossible to drain the unit but assuring that the pressure drop will be limited to such a value that steam temperatures will not decrease faster than the 70 F per hr specified as a reasonable cooling rate. Too fast a cooling rate would cause unequal temperatures throughout the unit which would result in high stresses and possible damage to refractory materials as well as metal parts.

When the drum pressure gage reaches 25 psi, the drum vents are opened and allowed to blow. This is to prevent pulling a vacuum on the pressure parts which might damage them, causing tube seats to leak. Cooling the unit with the drum vent closed can result in high vacuums as the steam is condensed to water with a resultant change from a high to a low volume condition. When the unit becomes cool enough to lay a bare hand on the furnace tubes without discomfort, the water is drained from the unit and men open handhole plates and drum manholes for inspection. The unit is carefully inspected for dirt and sludge deposits and to make sure that all interior metal surfaces are clean and free of oil. Headers and drums are flushed out using high pressure water hoses and the large circulators are carefully washed down. The inspection and cleaning operations are slow and tedious and dirty, wet men are seen crawling in and out of the manholes to complete their distasteful tasks. And as the various sections are cleaned and pronounced free of dirt the handhole plates are replaced so that no accidental entry of foreign material is possible. Finally the work is completed and the drum manholes are bolted up and the unit is again ready to be filled with water.

The erection crews are working with frantic haste because the final starting up date is only a few days away. Last minute changes and alterations are made. The low rumble of pulverizers and the soft hum of primary air fans indicates that the service engineers are calibrating and setting the mills for actual firing conditions.

The hurry and bustle of the work continues up to the very morning of the starting up day. A few minutes before actual operation is to commence this activity seems to come to a standstill. The operating crews gather for one last, brief session of instructions which have been repeated many times before. The boiler unit towers into the building above the men who are making ready to bring it to life—a huge, majestic structure with an air of strength and massiveness which cannot be hidden by the unpainted steel and the unfinished insulating surfaces. The new unit is waiting to be placed in service and the cleaning and dressing up can be done any time. A new plant is on the verge of coming to life and the very air seems to be charged with the message that the starting up day is now at hand.

READING MEGAWATT METERS

IN MOST PLANTS the generator integrator megawatt meters are read every hour on the hour by the switchboard operator and from this reading a block curve is drawn, and other data are figured. In plants where only one switchboard operator is on duty, this reading may be delayed due to a circuit tripping out or some other similar trouble. Late reading of the integrators will cause the block curve to be wrong and the office staff to have unkind thoughts about the operator.

Most operators attempt to estimate the error introduced by reading the meters late and use several methods. The most accurate method and one that requires a minimum of bookkeeping is as follows:

1. Record on a scratch pad the number of minutes late and read the meters. The amount generated is also recorded on the scratch pad.
2. The total load on the station at the time is noted.
3. The error introduced by the delayed reading is found by the following formula:

$$\frac{\text{Minutes late} \times \text{total load}}{60} = \text{Amount of Error}$$

3. The Amount of Error is then subtracted from the amount generated since the last reading and the the result is the amount integrated during the hour.

For example, if the reading is delayed seven minutes, and the integrators showed a total of 27.4, and the load on the station was 24 megawatts.

$$\frac{7 \times 24}{60} = 2.8 = \text{Amount of Error}$$

$27.4 - 2.8 = 24.6 =$ Generation for the Hour

The same method may be used to check one's figures when it might be suspected that a mistake was made in reading the meters. The method may also be used to prepare a chart to enable the operator to tell at a glance what error is introduced by a delayed reading. Such a chart would eliminate pencil work at a time when the operator is very busy. JACK FALON

DELAY IN MINUTES	TOTAL MEGAWATTS																						
	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70
1	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.1	1.1	1.1	1.2
2	0.9	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.9	1.9	2.0	2.1	2.1	2.2	2.3	2.3
3	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.4	3.5
4	1.8	1.9	2.0	2.1	2.3	2.4	2.5	2.6	2.8	3.0	3.1	3.2	3.4	3.5	3.6	3.7	3.9	4.0	4.1	4.3	4.4	4.5	4.7
5	2.2	2.3	2.5	2.7	2.9	3.0	3.2	3.3	3.5	3.7	3.9	4.0	4.2	4.4	4.5	4.7	4.8	5.0	5.2	5.3	5.5	5.7	5.8
6	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	6.8	7.0
7	3.0	3.3	3.5	3.7	4.0	4.2	4.4	4.7	4.9	5.1	5.4	5.6	5.8	6.1	6.3	6.5	6.8	7.0	7.3	7.5	7.7	7.9	8.2
8	3.5	3.8	4.0	4.3	4.5	4.8	5.1	5.3	5.6	5.9	6.2	6.4	6.7	6.9	7.2	7.5	7.7	8.0	8.3	8.5	8.8	9.1	9.4
9	3.9	4.2	4.5	4.8	5.2	5.4	5.7	6.0	6.3	6.6	6.9	7.2	7.5	7.8	8.1	8.4	8.8	9.0	9.3	9.6	9.9	10.1	10.2
10	4.3	4.7	5.0	5.4	5.7	6.0	6.4	6.7	7.0	7.3	7.7	8.0	8.3	8.7	9.1	9.3	9.7	10.0	10.2	10.3	11.0	11.3	12.3

ERROR IN READING (INTEGRATORS)

Chart showing errors introduced by delayed readings of megawatt meters

Water Test Chemistry Helps You Operate Softener Better—I

What happens in the sample when you make a feedwater test and why is that important? . . . Why does phenophthalein indicator turn red in a solution containing carbonate ions? . . . Why does methyl orange change the sample color from yellow to light pink. . . . The author here tells you the exact chemical changes that take place in your sample when you are running your test and why . . . He then shows how these facts are interpreted in the operation of the water softener itself, using the particular case of the lime-soda softener . . . Part II in a future issue will continue the interpretation . . . This 2-part article is a continuation of the discussion of testing of boiler water begun by Mr. Fleming in the June 1945 issue, where he gave complete directions for making the standard water tests . . . The present article, however, gives information on the tests and on softener operation that you will find elsewhere . . . It should be read in connection with Mr. Fleming's original instructions or the step-by-step instructions by E. O. Davis in the October, 1945 issue

By URBAN C. FLEMING, JR.
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IN ORDER that power plant operators who carry out the basic feedwater tests may understand clearly the principles involved in these tests, a short explanation of what chemical reactions take place in the test solution during these tests appears to be in order.

We may begin by stating that alkalinity in a water sample is due to the presence of hydroxide ions (OH^-) in the water. The hydroxide may be present as free hydroxide ions (OH^-) in the water or may be provided by hydrolysis or reaction with water of certain ions present in the water sample.

What Are the Ions?

The ions which will be encountered in feedwater conditioning and which can provide hydroxide ions by their hydrolysis are carbonate ions ($CO_3^=$), bicarbonate ions (HCO_3^-) and phosphate ions ($Po_4^=$).

Carbonate ions hydrolyze to produce hydroxide ions by the following reaction:

$$\underset{\text{carbonate ion}}{CO_3^=} + \underset{\text{water}}{H_2O} \rightarrow \underset{\text{Bicarbonate ion}}{HCO_3^-} + \underset{\text{hydroxide ion}}{OH^-}$$

This hydrolysis is sufficiently great so that the amount of hydroxide produced raises the pH of the water above 8.4 and, therefore, phenolphthalein indicator will turn red in a solution containing carbonate ions.

Note: Phenolphthalein indicator is red in any solution having a pH above 8.4 and is colorless in any solution having a pH less than 8.4.

Bicarbonate ions hydrolyze likewise to produce hydroxide ions but the extent of the hydrolysis is much less than in the case of carbonate ions and the amount of hydroxide ion produced is only sufficient to raise the pH of the solution to about 8.3. Therefore, phenolphthalein indicator will be colorless in a solution containing only bicarbonate ions.

We may mention at this point that phosphate ion also hydrolyzed to produce hydroxide ions but for the purposes involved in this article it will not be necessary to go into the theory of phosphate ion hydrolysis.

The hydrolysis reaction for bicarbonate ion is

$$\underset{\text{Bicarbonate ion}}{HCO_3^-} + \underset{\text{water}}{H_2O} \rightarrow \underset{\text{Hydroxide ion}}{OH^-} + \underset{\text{Carbonic acid}}{H_2CO_3}$$

When acid is added to a solution containing carbonate ions the following reaction takes place:

$$CO_3^= + H_2O \rightarrow \underset{\text{Hydroxide ion}}{OH^-} + HCO_3^-$$

OH^- + H^+ (Hydrogen ion from acid) ↓ H_2O (Water)

Hydroxide Ion To Water

The hydroxide ion formed in the hydrolysis is converted to water by reaction with the hydrogen ion of the acid. It must be remembered that only a small amount of the carbonate ions had originally hydrolyzed to produce hydroxide ions. However, upon the addition of the acid the hydroxide which had been formed by hydrolysis was removed by combining with the hydrogen ion from the acid to form water. Since the equilibrium in the solution has been disturbed more carbonate ions must hydrolyze in order to re-establish the equilibrium. This hydrolysis, therefore, continues until all the carbonate ions in the solution have been converted to bicarbonate ions, since the final products of the reaction are bicarbonate ions and water. Likewise, any free hydroxide ions originally present in the solution will have been converted to water by reaction with the acid as follows:

$$\underset{\text{Hydrogen ion (from acid)}}{H^+} + \underset{\text{Hydroxide ion}}{OH^-} \rightarrow \underset{\text{Water}}{H_2O}$$

When all the hydroxide ions have been converted to water and when all the carbonate ions have been converted to bicarbonate, the pH of the solution will be less than 8.4 and therefore the phenolphthalein indicator will be colorless in the solution.

Methyl Orange Reactions

In the methyl orange alkalinity test, the hydroxide is converted to water by reaction with the acid. The carbonate ion is converted first to bicarbonate ion, as indicated above and, upon further addition of acid, the bicarbonate ion is converted to carbonic acid in the following reaction:

$$\underset{\text{Bicarbonate ion}}{HCO_3^-} + \underset{\text{Hydrogen ion}}{H^+} \rightarrow \underset{\text{Carbonic acid}}{H_2CO_3}$$

The pH of the solution is then lowered upon the addition of one drop of acid to below 3.8 and the indicator, methyl orange then changes in color from yellow to light pink. This is the endpoint of the titration and at this point all the alkalinity in the water due to carbonate ions and hydroxide ions and even bicarbonate ions has been neutralized.

It should be mentioned at this point that, at the phenolphthalein endpoint, the carbonate ions have been half neutralized and at the methyl orange endpoint the carbonate ions have been completely neutralized.

Lime-Soda Softener Effluent

In the following discussion the assumption is made that the water being dealt with is the effluent from a lime-soda softener.

Lime has the chemical formula $Ca(OH)_2$ and provides free hydroxide ions in the solution. Soda ash has the chemical formula Na_2CO_3 and provides carbonate ions in the solution.

When a water has been properly treated in a lime-soda softener, all the hardness in the water both temporary and permanent has been converted to relatively insoluble calcium carbonate and to magnesium hydroxide which is very insoluble. After this treated water has been filtered there will remain a small amount of hardness which is due to the fact that calcium carbonate is slightly soluble.

In the case of a cold-process lime-soda softener, the hardness may be as much as 50 ppm expressed as calcium carbonate. In the case of a hot process lime-soda softener the hardness may be as low as 15–20 ppm expressed as calcium carbonate.

The calcium carbonate in solution provides both calcium ions (Ca^{++}) and carbonate ions to the solution. The calcium ions will be measured in the hardness test and the carbonate ions will be measured in the alkalinity test.

There will be also present in the softener effluent free hydroxide ions due to the excess lime fed to the softener and

carbonate ions due to the excess soda ash fed to the softener.

Total Alkalinity

The total alkalinity in the effluent will be due to

1. Free hydroxide ions.
2. Carbonate ions due to excess soda ash.
3. Carbonate ions due to calcium carbonate.

Since we wish to maintain certain limits for hydroxide alkalinity and for carbonate alkalinity (to provide for most efficient operation of the softener) we must be able to determine how much of the total alkalinity in the water is due to free hydroxide, how much is due to excess soda ash, and how much is due in carbonate ions from calcium carbonate in solution.

In the phenolphthalein alkalinity test the amount of acid used is a measure of the total hydroxide concentration and one half the carbonate concentration. At the phenolphthalein endpoint, all the hydroxide has been removed from solution in the form of water and all the carbonate ions have been converted to bicarbonate ions (i.e., half neutralized). The chemical reactions which take place during the phenolphthalein alkalinity test are

(1) OH^- + H^+ → H_2O

Hydroxide ion + Hydrogen ion (from acid) → Water

(2) $CO_3^{=} + H_2O \rightarrow HCO_3^- + OH^-$

Hydroxide ion
+
H^+ Hydrogen ion (from acid)
↓
H_2O

It is apparent that in the phenolphthalein alkalinity test the hydroxide ions are converted to water and the carbonate ions are converted to bicarbonate ions. (The carbonate is half neutralized).

In the methyl orange alkalinity test the hydroxide ions are converted to water and the carbonate ions are completely neutralized and converted to carbonic acid.

The chemical reaction for the neutralization of hydroxide has been given under the discussion of the phenolphthalein alkalinity test and the reaction for the complete neutralization of carbonate is as follows:

$CO_3^{=}$ + H_2O → HCO_3^- +

carbonate ion → bicarbonate ion

OH^- + H^+ → H_2O + HCO_3^-

hydroxide ion + hydrogen ion (from acid) → bicarbonate ion

HCO_3^- + H_2O → H_2CO_3 +

bicarbonate ion → carbonic acid

OH^- + H^+ → H_2CO_3 + H_2O

hydroxide ion + hydrogen ion

The carbonate ion is first converted to bicarbonate ion upon addition of acid and upon further addition of acid the bicarbonate ion is converted to carbonic acid.

(To be continued)

LETTERS AND COMMENTS

MUSCLE DOESN'T ALWAYS WORK

JUST AT OUR entrance into the World War II, I was hired as an engineer aboard a Diesel dredgeboat. This boat had an old air-injection type engine with 6 cylinders (which had come out of one of the U. S. Navy submarines from World War I.)

We were having trouble with a valve assembly of a type that was hard to replace so we had to try and save it as we had only one other spare. The valve assembly had to be taken apart to check on the condition of the valve stem and seat.

We had a couple of hours overtime work two days a week in order to catch up with needed repairs. Our Chief had a job where he was always on the move, as there was plenty of work to be done on the day-shift.

On the day that this incident occurred, the Chief was busy and plenty burned up because of a stoppage due to lack of sufficient fuel for engines. The Chief and one of the other engineers had tried to break this valve body loose. On the lower part of the valve there was a square protrusion designed for the use of a wrench. But as there was no wrench for this valve an open end wrench was tried; then a 24 in. monkey wrench. Neither of them worked. So on this morning that the Chief was riled up, I had to assist him on repairs. After getting the paper work done the Chief wanted to give this valve assembly another try. So he sent me for a 24 in. Stillson wrench. When I got it and got back to the work bench, it dawned on me what he was going to do.

I didn't use my head although I knew that the Chief was in a bad mood. I piped up, "I wouldn't do that, Chief, because there's a possibility of twisting the valve out of line." Then he blew. "Just what the h—— would you do, squirt?" he bellowed at me.

"It is OK if I try to break it loose my way?" I asked him. He told me to go ahead and try it but that it wouldn't do any good. Well, to start, I left the valve assembly in the vise, got out the blow-torch and prepared it for the operation. After the torch was ready I put heat to the valve. When this was good and hot I got a piece of wire about 15 ft long so as to tie one end around the valve body and a loop on the other end for my hand. Then I heated the valve again to where it was as hot as I wanted it, removed it from the vise and let it hang over the ship's side into the river for a minute or so, long enough to cool the valve. After I had brought it out of the water and put it back in the vise, I used the open end wrench on the square part of the body and it could be loosened with one hand on the open end wrench.

After getting it loose I told the Chief how it was done. He had cooled off by this time and said, "Often wondered how you little squirts stayed in this engineering field. Now I understand. It isn't all muscle." This Chief was a hard worker and a square shooter and ready to listen to other ideas, but, like the sailor he had been, he talked loud and would scare the daylights out of the engineers.

WILLIAM T. MULLEN

ACCIDENTS STILL PERSIST

SEVERAL WEEKS ago I wrote an article on how our plant electrician got burnt on account of his cap touching an open switch. This time it was on the same switchboard only an insurance inspector started a freakish chain of events that led to a shut down and stopped production for over an hour and one of my operators got badly burned about his face and eyes.

I happened to be off this day and the insurance inspector came in to make a routine check on the switch gear. While walking past the board he felt the heat coming off one of the 60 amp fuses on an open knife switch. This switch was not overloaded as he thought but one of the fuse clamps was making a poor contact.

He decided, however, to test it out with his tong tester. Whatever possessed him to clamp it around the open fuse God only knows. After clamping the tester around the fuse he got a satisfactory reading, and proceeded to unhook the tester when one claw hit the middle leg of the knife switch. There resulted a terrific explosion and a flash.

The tester fused into the switch blade, the inspector's hands got badly seared and my operator who happened to be a head taller, and was standing in back of the inspector got badly burned around the face and eyes. Fortunately, his vision was not damaged by the copper that flew around although some did get into his arm.

Due to this mishap the voltage dropped and the low voltage relays tripped out, shutting down the induced draft fan and the blower in the boiler room. In the confusion that resulted from this mishap, by the time anyone was able to find out what had happened, the steam pressure had dropped from 200 psi down to 110 psi which was not enough to operate the turbines. They had to dump the load in order to keep the turbines running. By the time things got organized and the smoke had cleared we had lost over an hour of valuable production time, two men were taken to the doctor for treatment, a

burnt out knife switch, and additional work and expense of installing a temporary hook up.

Incidentally, the same electrician who got burnt the last time, had to jerk the tong tester off the switch which was practically fused in.

This would not have happened had he used a tester that had been insulated with rubber. The one we use in the plant has a rubber insulation around the claws. Another thing he should have gone behind the board and clamped it on the insulated wire which we are in the habit of doing.

I now have a switchboard that has evidence of two flashes. In spite of the fact that I had warned my men to be very careful and use precautions, an outsider comes in who is supposed to show us where our mistakes are and teach us corrective measures; he through thoughtlessness upset the apple cart.

JOHN F. SLAVINSKY

Ridgefield, New Jersey

THE POWER PLANT GOES TO SEA, BUT THE SUPERVISION STAYS ASHORE

IN READING the July issue, I ran across Alfred F. Bailey's comment. This too, is my first comment for publication. I, also, do not disagree with Mr. Goldsmith, I sailed the ships he referred to, namely T.2. Tankers.

We had the same main unit and two auxiliary units as Fig. 1 shows.

We didn't have flow meters but had Bailey automatic combustion control and automatic feedwater control. This includes Reliance Eye-Hyes in the engine room, for the instant inspection of the engineers; salinometer (Bendix); draft manometers; oil gages; steam gages at inlet and outlet of turbine; Cochrane deaerating heater; Dearborn system of water treatment; and automatic trips if oil supply fails. This system was gravity fed, but I believe Mr. Goldsmith's ships had independent motor-driven oil pumps for main and auxiliary units.

All auxiliary equipment was electric driven, except two turbine feed pumps and one piston-type double-acting feedwater pump.

We carried an electrician who did all the megging, not only on main unit but on all electric motors.

As I recall it, this pump shown in Fig. 3 was on the starboard side on the turbine operating deck just aft of the fuel oil bunker. Also the valving was identical.

The main reason that I didn't bother getting a Marine Engineer's license is that trying to explain to the "old sea dogs," as they call themselves, or "old hands" as Mr. Goldsmith describes them, would be like a child telling his teacher black is white. On that score I heartily agree with Mr. Goldsmith that for these turbi-electric drive ships, young engineers with no set ideas make the best operating engineers, for they are easier to break in right.

Chicago, Ill. M. H. OSTRANDER, JR.

NATIONAL SPOKESMAN

I WAS MUCH interested in A National Spokesman for Engineers in June issue and think Mr. Stickney brings out many good points. But there's one flaw in his recommendations. He suggests that the magazine of the master organization sell for a dollar a year and the rest of the revenue needed to run it be derived from advertising. This means that this magazine must compete with the magazines put out by its subordinate organizations and might create friction, I mean compete in the sale of advertising. It would be better for the subscribers to pay more per year so as to make it independent of advertising.

Mr. Stickney also fails to make specific mention of the power engineers and his particular problems at any point in his article. Many of us engineers would like to read an article which gave special information on the special problems of power engineers. We have a great many organizations for elevating the engineer, but none of them seem to get us very far. What we would like to read is something which applies more to the power engineer and his own problems.

WILLIAM T. MULLEN

OPPORTUNITY KNOCKS

I HAVE READ with interest the two letters in the August issue of POWER PLANT ENGINEERING entitled "Opportunity Knocks" and submit the following comment:

It has always been the feeling of the writer that friendly, constructive criticism, in whatever line, produces a broader knowledge of the problems of both labor and capital and makes for progress throughout the whole social structure.

It would seem that the personal by-play between J.R.D. and H.E.D. has ended somewhat in favor of H.E.D. since he has found not one but two mechanical engineers who are willing to accept both the conditions of employment and the salary offered.

This leads us to the question as to why some men, such as H.E.D. has found, are willing to accept the long hours and a salary that J.R.D. calls "chicken feed" while some others take the attitude of J.R.D. who wants "40 hours per week, a salary of $6000 per yr and an assistant at $200 per month."

Since J.R.D. is a Professional Engineer and is listed in "Who's Who" it is fair to assume that one of his professional attainments can, in these days at least, secure an outlet for his ability as a consultant commensurate with the salary which he demands.

It is also fair to assume that he has had the advantages of a technical education since his Society connections would seem to require such a standing.

It is true that these educational advantages may have been secured through his own efforts and, if so, credit should be given, but not all of us have been so located, geographically or otherwise, that these advantages could be secured, hence our knowledge of the trade or profession in which we choose to engage has to be secured by practical experience on the job, supplemented by reading some of the technical magazines pertaining to our line of work, or by correspondence courses which are offered by some of our advanced institutions of learning.

Consultants are in a position to secure for their services whatever they feel they are worth since payment for service rendered is usually on a percentage of job costs basis or a fixed per diem fee and it can be readily established that most managements of moderate sized industrial plants lack the engineering ability to judge the value of a consultant's services, whereas the day to day value of a full time employee, in close touch with management, can be quite quickly evaluated.

Our consultant would not contract for a suit of clothes without being fitted; purchase a house without a thorough inspection of the title to the property or the material and workmanship which entered into its construction and, by the same token, the employer wants to know something of the ability of the engineer before the salary is based too high.

Several years ago the writer accepted a position which necessitated moving some 150 miles to an entirely new location at a very small advance in salary and at a figure much lower than he had reason to believe the position would ultimately pay, and at the end of 60 days was given an unsolicited substantial advance in salary and subsequent advances followed in later years.

It is probable that the party who accepted the position advertised by H.E.D. saw in it an opportunity to broaden his experience and increase his technical knowledge and considered this gain to be worth the price he would pay in longer hours and moderate salary.

In examining the qualifications required in a successful applicant for the position advertised they seem at first glance to be somewhat versatile but with a more careful analysis a satisfactory working knowledge of all the skills named are well within the capabilities of one of average intelligence within the age specified.

The fundamentals of drafting are not difficult to master and when one has learned the relative positions of the various views of any object it is wished to portray, it is only a question of developing hand skill.

A finished drawing is only a refined version of a pencil sketch and most mechanics are able to do an understandable sketch free hand. A few years of diversified machine shop experience should be sufficient for the applicant to handle such lathe and drill work as would be necessary in a plant of that kind.

Experience with refrigerating machinery is available in nearly any city of moderate size and knowledge of the principles of dehydration is now quite common.

As regards the professional status of

engineers in general, both consulting and mechanical or operating, it is the writer's opinion that each should, and in many cases does, complement the other.

In major plant changes involving structural design, installation of prime movers or steam generating equipment with their numerous auxiliaries, technical advice from competent consultants is usually required and desirable.

Handling of contracts with vendors of such equipment is also a desirable function of the consultant. However, in such cases it will be in the interest of harmony between consultants, operating personnel and management if those responsible for plant operation and maintenance are consulted from time to time for suggestions on plant layout since they are the ones who will have to live with the finished plant and a badly designed plant can be the source of much labor friction and operating expense.

The writer has in mind a case where an oil burning plant was changing to coal during an oil shortage. Boiler ratings were moderate and side dump stokers were to be installed. Furnace volume was liberal and when the plant was modernized several years before, the boiler room operating floor was raised to provide for a nine foot basement at ground level to accommodate auto trucks for ash handling in case it was desired to burn coal.

Consulting engineers were engaged to make the necessary furnace and stoker layout, coal handiing equipment, etc., and after a careful study they reached the conclusion that no satisfactory ash pit could be designed which would drop the ash direct to a truck in the basement and proposed to install a closed bottom pit, haul the ash out manually to the operating floor and drop it to the ash truck through a chute in the operating level floor.

While preliminary plans were being drawn by the consultants, the Chief Engineer of the plant went to work on the problem and in a few days submitted a drawing for an ash pit which the consultants and the stoker manufacturers accepted and which was in use with entire satisfaction and no maintenance cost whatever for a period of over two years and resulted in a labor saving of one full time man during a period when man power was extremely short.

This incident serves to illustrate what can be accomplished when the practical experience and ability of the chief operating engineer of any plant, although he may not have the advantages of a technical education, is recognized by the plant management and the consulting engineer is not afraid of losing face when the suggestions of the plant operating force are considered at their true value and, when practical, are accepted.

In answer to the question as to why some men are willing to accept long hours and moderate compensation for service rendered, I trust the reader will pardon the writer's reference to his personal experience which I think constitutes a fair answer.

Fascinated from his early youth by the sight of a steam engine, there never was any question in the writer's mind as to what he would like his life work to be. Formal schooling ended with the grammar grades as no high school existed in his country town and in any event financial circumstances dictated self support at an early age.

At twenty-three years of age, opportunity came in the shape of a position as oiler in a large steam plant in a city of 100,000 people 150 miles distant and not a single acquaintance among them. The hours were 10 per day for 7 days a week and the salary was $10.50 per week but it afforded an opportunity to acquire the necessary experience and the practical knowledge necessary to mount the first rung of the ladder at whose top was the unlimited gold seal license which the State required for plants of unlimited size.

Seven years of long hours and hard study at home, supplemented by the kind assistance of fellow members of the local Engineers Association, many of whom had reached the top by the same hard road, were required to secure the coveted gold seal which signified that the holder was a safe and competent engineer.

No opportunity to change from one position to another was neglected if it meant experience on new equipment. The hours were often long and the physical labor between the handles of a coal barrow or at the small end of a coal scoop in the early days of my "learning by doing" was hard but the practical knowledge gained has been of much value in training others.

The reward for the effort put forth has been found, in the writer's case, in the opportunity of following a chosen profession among congenial companions, the enjoyment of a comfortable home, a college education for my two children, which they have amply justified, and for the past twenty-six years a position as Chief Engineer with a large and progressive industrial plant.

To the readers of the correspondence between J.R.D. and H.E.D., I would say if circumstances permit, by all means secure a technical education, with its superior opportunities but if your journey to the top of the ladder must start humbly and progress the hard way, as did mine, do not hesitate to accept the conditions necessary for the rung to rung climb. The reward is worth it.

Plymouth, Mass. C. BROOKS HUDSON

Questions And Answers

Question No. 348

AIR COMPRESSOR QUESTIONS

1. PLEASE explain how to set up and line up an air compressor.

2. What is the relationship between an electrical horsepower and the horsepower of compressed air, if there is any such thing? I am thinking about a compressor to be driven by a 2200-v motor and to produce air at 120 psi.

Canton, Ohio O. E.

Question No. 349

HOW TELL WHETHER COAL OR OIL IS CHEAPER TO BURN?

WITH coal at $10.50 per ton and 14,000 Btu per lb and Bunker C oil at $52.00 per thousand gallons, which is the cheaper to use? We have had three answers to this question: First, no saving on either; second, coal is cheaper; and third, oil is cheaper.

I am under the impression that all three of these answers may be correct. That is, where coal showed a saving, the particular furnace was not a furnace efficiently designed for oil burning or vice versa.

A number of my fellow operating engineers would like the views of Q & A readers on this problem, especially those whose plants are equipped with all the required metering devices so that they really know what is going on.

Springfield, Mass. H. G. C.

Question No. 350

WHY DO HIS AUTOMATIC STOP VALVES CHATTER?

MY POWER PLANT consists of two 300-h.p. B. & W. straight-tube, water-tube boilers, supplying steam for: the heating of two buildings; two Skinner steam-tight counterflow engines each connected to a 200 kw generator; a hot water heater; and a cafeteria.

The steam consumption of the latter two is not heavy. Also, one building is heated by exhaust steam during the day time. The boilers are fed by a Worthington 10 by 6 by 10 duplex steam pump and the water is heated by a Cochrane heater.

Am experiencing a chatter in the 6 in. automatic stop valves on the boilers which has completely ruined them. Apparently it's the pulsation of the steam in the main steam line that is doing the damage.

Have kept the steam pressure right at the peg, have drilled a 5/32 in. hole in the pistons of the automatic valves to kill any uneven pressure or a vacuum if it could exist, screwed down on the piston with the valve stem, to stop the chatter, but no results.

Has anyone a remedy for this trouble?

New York C.G.C.

Question No. 351

WHY DOES HE HAVE TO ROLL TUBES OFTENER?

WE HAVE two 200 hp horizontal boilers and our load is such that we run 400 hp for a few hours and then it immediately drops to 50 hp. We are keeping the boiler water hardness very near zero at all times, but at different times our chlorides run a little higher than recommended. Trouble we are now experiencing is that we have noticed that the tubes are needing more attention than in the last year and we have rolled some of these tubes three times. Could you give us any suggestions on how to overcome this trouble? Also, should we weld the tubes to the boiler plate?

Morrisville, Vt. L.L.C.

Question No. 352

CAN HE USE THE EARTH TO REDUCE TEMPERATURE OF COOLING WATER?

I HAVE an idea for using a pipe buried in the ground to absorb heat from refrigerant cooling water and would like to know how to calculate the amount of pipe required; that is: how much heat transfer surface must I have to get the required temperature reduction?

The purpose of the scheme is as follows: Evaporative refrigerant condensers present a maintenance problem and cooling towers and ponds require considerable space. Why wouldn't it be practical to bury the pipes, getting them out of the way, the only maintenance being their replacement every 20 yr or so?

Cooling water at 95 F is to flow through a 6-in. pipe buried in the ground. I want to reduce the temperature of the water to 70 F.

Now the problem is, will the temperature of the ground at various seasons of the year be low enough to give this cooling effect? How much pipe must I have in contact with the earth, that is, how much pipe-to-earth heat transfer surface? The NDHA Handbook gives 0.9 Btu per hr per sq ft per degree temperature difference as the heat transfer coefficient for moist earth and 0.2 for dry earth. For practical reasons of cost and operation, I assume the pipe should be straight. But how about a set of straight, parallel pipes connected at each end to a manifold?

Chicago, Illinois L.F.C.

Editor's Note—If this plan would work out as a water cooling device, there would seem to be a very practical application for cathodic protection. See POWER PLANT ENGINEERING, June, 1946, page 83.

Question No. 353

WHAT IS GALVANIC ACTION BETWEEN TWO DIFFERENT METALS IN WEAK ACIDS?

CAN YOU and the readers of POWER PLANT ENGINEERING supply any detailed information regarding the galvanic action between two different metals working in a very low percentage acid?

In my former part of the world, Europe, this matter was of great importance in the operation of condensers because of the effect on condenser tubes in the presence of decarbonized circulating water ($H_2O \times HCl$) as well as the action on the shaft of a turbo-generator in the presence of oil and electrical current.

At present I face the problem of using monel metal together with brass, copper and steel in a low acid liquid. Hence I shall appreciate any information you can send me on galvanic action under such conditions.

Philadelphia, Pa. M. J. W.

Editor's Note—Tables of contact potentials of various metals and potentials in various solutions are given in the following books: (1) *Chemical Tables from Handbook of Chemistry and Physics* by Hodgman, Published by Chemical Rubber Publishing Co., Brooklyn, N. Y.; (2) *Smithsonian Physical Tables* by Fowle; Publication 2539, 1923; pages 312 to 316.; Smithsonian Institution, Washington, D. C.

However, very little is said about the potentials in weak acids and not much about monel metal and steel.

There is also considerable discussion of this subject in connection with the chemistry of water treatment for both boiler feed and industrial supplies and also for condenser circulating water, and in studies by various manufacturers of corrosion of condenser tubes. It is also related to the subject of cathodic protection. (See POWER PLANT ENGINEERING, June, 1946, page 83.)

Reference to the Industrial Arts Index will yield many references in the current literature on all these subjects. Any coments from readers showing information they have found helpful and practical in solving such problems will be greatly appreciated.

Answer No. 328

WHY GREATER PRESSURE DROP WITH LIVE STEAM THAN WITH EXHAUST STEAM?

Principles Correct, Calculations a Bit Off, says McKinney

MR. SEPTOR'S reply to this problem in the June issue brought out the interesting point that inability to get sufficient heat from low-pressure steam may be due to small pipes.

This is often overlooked when using exhaust steam from back-pressure turbines. The raising of the exhaust pressure reduces the electrical output which must often be replaced by power from condensing turbines at greatly increased cost.

While agreeing with Mr. Septor in principle, may I question some of his calculations?

Would not the division of 1192.3 by 26.36 be 45.23 instead of 41.43?

The total heat in 17 psia saturated steam is 187.56 plus 965.5 = 1153.1 Btu. If it contained 10 per cent moisture would not the total heat be 187.56 + (965.5 × 0.90) = 1056.5 Btu? Mr. Septor used 1040 Btu which is approximately 1153.1 × 0.90.

Berlin, N.H. RALPH MCKINNEY

Septor Will Write No More Answers While Listening to GANG BUSTERS

REGARDING MY answer to Question No. 328 in the June issue, all I can say is, Mr. McKinney is correct; 1192.3 ÷ 26.36 equals 45.23 Btu, not 41.43 Btu. An inexcusable error, the kind we used to make back in the sixth grade.

The total heat of the exhaust steam —1040 Btu—was taken from the Mollier chart, at a point between 10 and 12 per cent moisture, then we inadvertently calculated the volume at exactly 10 per cent moisture. Again inexcusable. The total heat per cubic foot of exhaust steam containing 10 per cent moisture then would be

$$\text{Btu per cu ft} = \frac{1056.5}{21} = 50.3$$

I am sorry, and I promise to stay after school and study my arithmetic, and I also promise NEVER AGAIN to try to listen to *Gang Busters* on the radio and work on a manuscript at the same time.

Thanks to Mr. McKinney for checking up, and for the corrections.

South Amboy, N.J. RAYMOND SEPTOR

EDITOR'S NOTE:—We share the blame for this. We should have caught it, even though *not* listening to *Gang Busters*.

Answer No. 315

HOW CALCULATE STEAM FLOW THROUGH SLOTS?

Correct Calculations, Taking Critical Pressure Into Account. Check Napier Formula Very Closely, Says Potter

IN ANSWER in the July issue, Mr. Parks has made several errors in his calculations.

The pressure at the throat of any orifice (the slots may be considered orifices) cannot be less than the critical pressure for the fluid flowing. In the case of steam under the conditions specified in the article, the critical pressure will be about 59 per cent of the initial absolute pressure. Assuming the initial pressure to be about 90 psia, the throat pressure will then be 90 × 0.59 or about 53 psia. Isentropic expansion from the initial conditions to the throat conditions will give:

$$h_{initial} = 1185.3 \text{ Btu per lb}$$
$$h_{throat} = 1143.5 \text{ Btu per lb}$$
$$41.8 \text{ Btu per lb}$$

Then $V_{throat} = 223.8(41.8)^{\frac{1}{2}} = 1447$ fps

In using the continuity equation ($wv = AV$), all values must be for the same flow section. Thus the specific volume must be taken at the conditions existing at the throat of the orifice, i.e., for a pressure of 53 psia and an enthalpy of 1143.5 Btu per lb. From the steam tables, the correct specific volume will be found to be approximately 7.7 cu ft per lb. Thus the weight of steam flowing through the orifice is

$W = (3600 \times 0.001517 \times 1447) \div 7.7 =$ 1025 lb per hr

There is also a mistake in the use of Napier's formula in that the pressure should be expressed in psi abs not psi g. The correct solution of this formula will be

$W = (3600 \times 90 \times 0.2184) \div 70 =$ 1010 lb per hr

Napier's formula is not accurate for many applications, but as shown above, will give results that are at least comparable for the range of conditions given in the article.

The above procedure of calculation may be verified in Marks' Mechanical Engineers' Handbook or in any standard textbook on thermodynamics.

Grand Forks, N.Dak. PHILIP J. POTTER

Answer No. 333

HOW BIG A RELIEF VALVE FOR ENGINE RECEIVER?

Calculation by Pef

THE FIRST STEP in the determination of the size of relief valve to use in the receiver of a compound engine is to estimate the total amount of steam to be handled. Assuming a 500-hp engine and a water rate of 50 lb per hp, the total steam that must escape through the relief valve is 25,000 lb per hr.

Napier's formula for flow of steam is $w = 50pA$, in which: w = lb per hr; p = pressure in lb per sq in. abs.; A = area in sq in. See above: W in lb per sec = $pA \div 70$. In lb per hr $W = 3600\ pA \div 70$ or $50\ pA$, approximately.

Assuming that the pressure in the receiver is 100 psi abs.

$25{,}000 = 50 \times 100 \times A = 5{,}000\ A$

$A = 25{,}000 \div 5{,}000 = 5$ sq in.

That means that the valve must have an area of 5 sq in., which means a 2½ or 3-in. valve, theoretically. The practical engineer will order a 4-in. valve.

Boston, Mass. N. T. PEF

Answer No. 337

HE WANTS TO CONVERT FROM STOKER TO OIL FIRING

How Emerson would Do it

IN READING the September issue, I was interested in the problem of C.H.W. in his conversion from stoker to oil firing.

I would like to express my views on this subject from a similar experience. My opinion is as follows:

1. The type of burner for the average small plant is, for my part, the steam-atomizing burner. Their construction is simple, oil temperatures are low, pump pressures are very low and maintenance is at a minimum. There are many factors too numerous to mention here in the choice of burner or fuel to be used but as this article is for oil I hope my views will help C.H.W.

2. Natural draft will be all that is necessary for average operation, provided there is a damper below the burner large enough to admit the required amount of air. This should be calculated upon the greatest amount of oil to be burned per hour. By all means have the damper and burner automatically controlled. This will eliminate excess air and allow higher efficiencies to be obtained.

3. The bridge wall can be used if desired but good results are to be had without it. If used, it should be moved towards the rear of the setting distance of about two fifths the length of the boiler. The height of the wall can be about three feet from the floor line. A Chicago arch may also be used, with or without a bridge wall. The main thing to remember is to keep the costs as low as possible and still get good results. A plastic coat is most desirable provided the side walls are in good condition. It prevents in leakage of air and reduces friction of the furnace gases in its passage through the setting.

4. Retain the present wall if in good condition. Get the greatest possible work out of it without added expense. This is of great importance.

5. Do not air cool the furnace floor; the hotter it is the better the combustion. This is, of course, within reason. Cold furnaces are not good for oil burning. Cracks in this floor will, if air cooled, let in undesired air, wasting costly fuel.

6. I think it is easy enough to get the stoker out of the way. The object is to get the conversion over with. For the boiler front, there is nothing like a cast iron one. When in place, get the center of the boiler itself and use it as a center line.

The center of the hole in the front can be from 24 to 30 in. from the floor line. This will depend upon the height of the checker work used. The burner tip should be kept as close to the brick work at the front end as permissible; as this aids in keeping the burner going.

West Roxbury, Mass. CHESTER V. EMERSON

Answer No. 342

HOW CALCULATE COMBUSTION SPACE?

IS THERE a specific formula for figuring the combustion space above the grates in a boiler of the straight tube type such as the Heine? Or does the type of boiler have any bearing on the matter?

In reply to these questions by C.F.M. in the August issue, we pointed out that there is a general method for doing this, rather than a formula. We reviewed, with the help of Gaffert, the factors to be taken into account.

Here is another comment, giving a very simple method of calculation based on an empirical rule about the allowable volatile heat release in the furnace.

Computation of Furnace Volumes by Elliot

FURNACE VOLUME above the grates for a straight tube boiler of the Heine type can be computed very simply by use of an empirical rule.

This rule consists merely of basing the volume on the now well-established estimate that one cubic foot of furnace volume may have a heat release of 18,500 to 19,000 Btu of volatile heat per hour.

This method of course, will provide a greater furnace volume for those fuels having a higher volatile content, as is usual in modern power plant practice.

Method of use can probably best be illustrated by an example.

Consider a straight tube boiler similar to a Heine boiler, with a steam load such that one ton of coal must be burned per hour. The fuel will be assumed to be an Indiana coal having the following proximate analysis:

Fixed Carbon	42.9 per cent
Volatile	36.3 per cent
Moisture	13.5 per cent
Ash	7.3 per cent

Heating value as received 11,543 Btu per lb.

The heating value of the fixed carbon is: $0.429 \times 14{,}600 = 6263.4$ Btu per lb of fuel.

The volatile heat in the fuel is therefore $11{,}543 - 6263 = 5280$ Btu per lb of fuel.

The number of pounds of coal that may be burned per hour per cubic foot of furnace volume is (using the lower heat release figure):

$18{,}500 \div 5280 = 3.51$ lb

Total heat release per cu ft $= 3.51 \times 11{,}543 = 40{,}515$ Btu

Furnace volume required for one ton per hour equals $2000 \div 3.51 =$ 569.5 cu ft.

This volume must be provided between the stoker and the first bank of tubes in a straight tube boiler.

If a spreader stoker is used, the average combustion rate will be about 35 lb per hour per square foot of grate area. The required grate area for 2,000 lb per hour is therefore $2000 \div 35 = 57.1$ sq ft.

Therefore the average height of the first bank of tubes above the stoker should be:

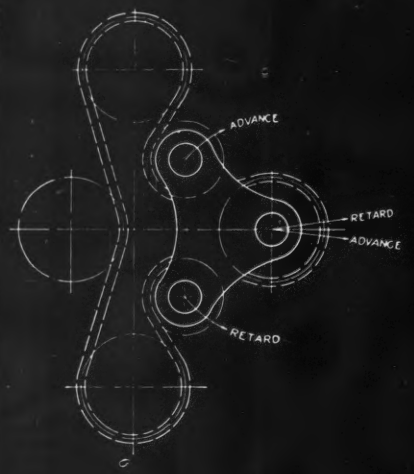
$569.5 \div 57.1 = 9.8$ ft.

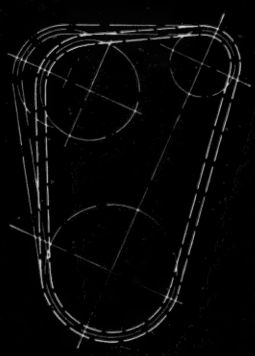
This method is not recommended for general application. It has been found satisfactory for semi-bituminous, bituminous and sub-bituminous coals. It has been applied successfully to natural gas, (assuming the carbon content as "fixed" carbon). To the writer's knowledge, this method has not been applied to anthracite or to fuel oil, and calculations for these fuels are open to question.

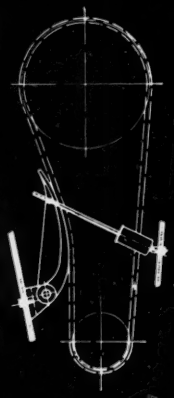
The method is not recommended for large central station plants using pulverized fuel firing or using open-pass boilers. It is satisfactory, however for industrial boilers, HRT boilers and small sectional boilers, and therefore should serve a very useful purpose.

Buffalo, N. Y. W. R. ELLIOT

TYPICAL LAYOUTS OF SHOES AND IDLERS







SHOES AND IDLERS

Except with duplex chain, idlers should be used only on the inside of the chain. For general industrial service, wherever possible, the use of a shoe on the back of the chain is preferable. Shoes are used to take up slack in the chain where there is no center adjustment, particularly on vertical drives where the small sprocket is below and the slack in the chain will tend to let it fall away from the lower sprocket.

The shoe offers a distinct advantage over an idler for this purpose. Its use eliminates chain joint wear due to the sharp bend in the chain running over a small idler. A shoe with its large radius of curvature on the surface will cause no appreciable wear on the back of the chain or on the shoe itself. The shoe should always be installed on the slack or idle strand. A shoe is quieter, it eliminates the use of a bearing, and simple means may be applied to take care of its action automatically. It is usually constructed of cast iron but for some purposes may be made of or faced with hard wood. The table below shows the minimum radius that should be used with each pitch and the typical illustrations show various types of shoes with their adjustments and mountings which have been successfully used. It is recommended that the design of such drives be referred to Morse Engineering Department for approval and comment.

MINIMUM RADIUS OF CAST IRON SHOES FOR MORSE TYPE 55 CHAINS

PITCH	3/8"	1/2"	5/8"	3/4"	.9"	1"	1.2"	1.5"	2"	3"
RADIUS	2.50"	6.25"	7.8"	9.37"	11.25"	12.5"	15"	18.75"	25"	37.5"

Minimum Radius of Backbend of Morse Type 55 Chains:—Pitch × 12.5

Courtesy Morse Chain Co.

LEADERSHIP BY PERSUASION

(*Continued from page 69*)

ask him to do it are agreeable to him. Manners are not absolute. The manners of the drawing room and the dinner table may not be suitable for the shop, just as manners suitable at a funeral are different from those at a wedding. The principal point is that the manners of the leader must be acceptable to those led, under the specific conditions of the situation.

10 *Assurance* (*Yours Is Contagious*). Individuals hesitate to take a course of action unless they are assured of success. That assurance is one of the principal elements of leadership. The leader knows in his heart that the proposed action is possible and that the results will be beneficial. That assurance radiates to those about him.

11 *Appeal to Pride* (*Satisfaction in Job Well Done*). All of us like to be held in high esteem by others. To justify that esteem we may put forth every effort of which we are capable. Satisfaction in a job well done is one of our rewards.

12 *Good Turn* (*One Deserves Another*). We all like to live in a free world where people are kind and generous to one another. By the interchange of good turns feelings of friendship are established. Many of us will go to any lengths for a friend, where we certainly would not for a stranger.

13 *Understanding* (*Know Your Man*). Although all of us respond to the general emotional appeals, there are always certain appeals peculiarly effective to certain individuals. In dealing with strangers these appeals are not available; but, especially where the leader must contact the same individual over and over, his contacts will be greatly improved by an understanding of what constitutes the other individual: What things can he do, what things does he like to do, what troubles and frustrations has he had, etc?

In listing the foregoing appeals to emotion, one appeal has been deliberately omitted; that is the threat of bodily harm. The early success of the Third Reich was built very largely on that one appeal. The old slogan, "Spare the rod and spoil the child," rests on the same basis. Today we believe that the better technique emphasizes the reward to the almost complete exclusion of punishment, although there are of course many cases where recourse must be had to punishment as a last resort.

Obstacles

We know to our sorrow that we are not always successful in our appeals to reason and emotion, and no coverage of the subject can therefore be complete without mention of those obstacles which prevent success. A number of these have been listed as follows:

14 *Habits.* Whenever one is asked to do something different from what he is in the habit of doing, the habit asserts itself as an obstacle. Even without thinking, we continue to make decisions based on habit which may not be at all justified by the situation of the moment.

15 *Fear* (*of a New Step*). Whenever one does something he has not done before, there is some small fear as to the outcome. When one is asked to do something which he has tried in the past with unpleasant consequences, fear may be very real.

16 *Inertia* (*Laziness*). The small child bursting with energy comes to his mother and asks what he may do. Most of us in later life are confronted with so many things that we must do that we naturally react against any new effort. It may be laziness—it may be merely inertia—but it is, in any case, an obstacle to activity.

17 *Complaint* (*Relevant or Not*). When we are asked to do something we have tried to do before, with unsatisfactory consequences, we naturally complain about trying it again. On days when everything about the world seems to be unsatisfactory, we have so many things to complain of that it is hard to fix our attention on compliance with some new demand whether or not it is related to the subjects of complaint.

18 *Ignorance.* We cannot do things about which we do not know. Therefore, until ignorance is replaced by enlightenment, it constitutes an obstacle to progress.

19 *Opposing Influence.* No leader has a monopoly on leadership. There are always other individuals or situations which bring influence in the opposite direction, and these opposing influences must be overcome before acquiescence is obtained.

20 *Time and Timeliness.* To do most things takes time. To get an idea into anyone's head takes time. Therefore mere time itself constitutes an obstacle to instant action. Likewise, there is a timeliness to things.

21 *Difficult Personality.* Some people have lived such lives of misfortune and frustration that their reaction to any proposal is negative. This negativistic tendency is a serious obstacle which, in the extreme cases, is overcome only by asking the individual to perform the reverse function to that which is desired. In general, dealing with a difficult personality requires both interest and sympathy.

Procedure

It is not enough to know all the factors pro and con affecting both reason and emotion unless we know what to do with the material after we get it. This comes under the heading of "procedure." The leader must of course first pick his *objective* (22). Having picked his objective, he must make an *analysis* (23), including all the necessary appeals to reason and emotion, especially emphasizing those appeals calculated to overcome the obstacles known to exist. The relevant information must then be arranged strategically.

In a letter or advertisement the case must be presented from beginning to end in one document. In the more general case of personal contacts the whole strategy may be outlined in advance, but the order of presentation may be fitted into the case as it develops. The first thing to do is to feel out the situation to determine what sort of man one is dealing with, if he is a stranger; or, if he is an acquaintance, to find out his mood of the moment. Next, the proposition should be presented in the way most calculated to secure favorable *attention* (24).

25 *Development of Proposal.* From that point on the various appeals are introduced in what appears to be the most expedient manner.

26 *Question to Measure Progress.* Progress in developing the proposal should be checked at frequent intervals, asking questions if necessary to determine what acceptance the prospect is receiving. Just as the proof of the pudding in the case of a salesman is the signature on the dotted line, so the acceptance of a request for action is the ultimate objective of any contact. That request must be made if the subject is willing to give an affirmative answer. If he once gives an emphatic negative answer, the going from there on is much more difficult. If the favorable moment is passed by, the chances of a favorable response may become increasingly unlikely. The request for action is therefore the pay-off; and the subject's answer is the final proof of whether all the previous steps have been properly taken.

It is hoped that the question of persuasion may be dealt with both adequately and comprehensively. When it has been so dealt with, a study of the subject will justify considerable effort since, no matter how well conceived a leader's objective may be or how much he may know about the technique required to achieve the end, his work will still all go for naught unles he can persuade his followers to follow him.

13,500 VOLTS— AND THE MONKEY WALKED

By John G. Reynolds

ATTENDANTS at the Pekin, Ill. power plant of the Central Illinois Light Co. recently had an uninvited guest in the person of a pet money, that gained access to the plant without their knowledge. Being a nosey creature the monk grabbed some "hot" wires on the transformer banks, and absorbed some 13,500 v of juice. He was so hot that his tail burned a hole in the steel cabinet where the electricity had flashed.

The attendants were about as surprised as the monkey when he got the "hot seat." When they found the source of the trouble lying inert on the floor of a cabinet they made short work of getting him out of the plant; however, just to show he resented the hospitality of the power plant he reared up in defiance and snarled a weary, painful snarl, his only indication that his experience had taught him that there's no room for "monkey business" around electricity.

Power Show Preview - 1946

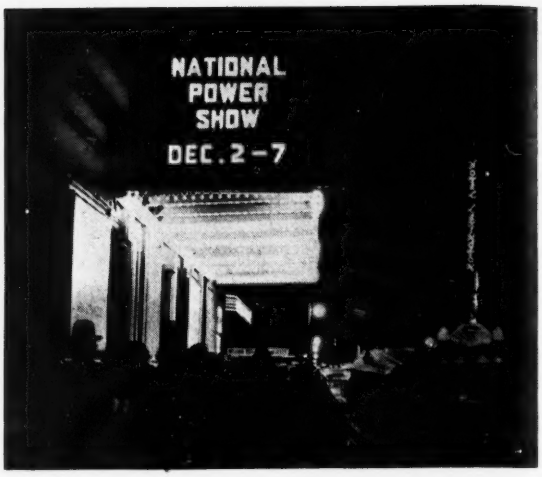


Fig. 1. Typical night scene at the entrance to a Power Show

PROGRESS in power engineering takes place as the result of scientific research and development. Men with vision conceive and formulate theories, put these theories to test to determine their accuracy in application, build equipment based on the proven theories, put this equipment to work, first in laboratories, then in commercial application in competition with older forms of equipment.

At every step there is the possibility that the new equipment may fail due to a faulty conception of the ultimate purposes of the equipment, wrong selection of materials used in construction, improper design of parts or for a multitude of other causes that were not foreseen prior to encountering the difficulty in applying the equipment. Then again, when all engineering difficulties have been solved to the satisfaction of the designer and builder, the problem of securing general acceptance of the product by the users of competitive equipment is encountered, often to fail of solution because of commercial reasons.

The Power Show to be held in the Grand Central Palace in New York City, December 2 to 7 will display and demonstrate to engineers of the country many changes that have been made in the design of equipment during the war years. These improvements need to be appraised for their value to industry.

At the time of writing this article, early in October, a study of the information thus far furnished to the manager of the Show indicated that by far the greatest number of products to be shown are 1946 designs of equipment that, except in details, are of standard construction long manufactured by the companies.

Manufacturers are taking advantage of developments in materials, such as iron, steel, copper, brass, plastics, fibers, mineral wools and ceramics, to increase the strength and life of their products, to fit them into high-pressure high-temperature service in modern industry, to reduce their corrosive tendency under contacts with acids, to lengthen life of permanent magnets or reduce hysteresis losses, and in hundreds of other ways to better their products for application in industry.

Model of Gas Turbine

Among the more spectacular developments which will be on display will be a scale model of what is believed to be the first gas turbine actually proposed and built for power generation in the utility field. This will be shown by Allis-Chalmers Mfg. Co. whose engineers have been pioneers in this country in the development of these new power generating plants and for years have been engaged in manufacturing power equipment such as remote indicating and control equipment for general industrial use, tap changer mechanism, speed changers, Magic-Grip sheaves, transformers, motor starters, precision casting blades, hydraulic turbine runners and boiler feed pumps all of which will be displayed in their latest designs.

In the display arranged by Aldrich Pump Co., the engineer will find pumps designed especially for desuperheating feed, a comparatively new application which is expanding with increased use of desuperheaters in industries. Latest designs of boiler feed and hydraulic pumps will also be shown. The latter are arranged for motor drive and air operation.

Boiler auxiliaries have advanced greatly in effectiveness of their application during recent years due in large measure to the development of adequate control methods. How this has been accomplished by fluid drives will be demonstrated by the American Blower Co. Their devices give smooth transmission of power and stepless speed control for boiler feed pumps, turboblowers and draft fans. New and improved forced and induced draft fans will also be shown, as well as fly ash precipitators—devices becoming essential to meet many city ordinances.

New Metals for Industry

Industry must give credit to the scientists who have developed metals that will withstand the services they are chosen to perform. Among the noteworthy displays of metals for various purposes will be that of the American Rolling Mill Co. which will show stainless and heat-resisting steels for applications in power plants, high temperature alloys which are extremely important for steam and gas turbines and jet engines to withstand temperature ranges from 1200 to 2000 F. A new alloy not previously announced will also be shown.

Fig. 2. Principal Booths at the Power Show will be occupied by manufacturers who have long been exhibitors. This view was taken in 1940

It is reported that the compact-type, packaged steam generating unit arranged for fully automatic oil or gas firing to be exhibited by Ames Iron Works Div. will produce 100 lb steam with feedwater at normal boiler room temperature in less than 30 min. Such units in sizes from 50 to 500 hp should have many applications in industries.

Steam using equipment is designed for the use of steam that is free of water which originates either as boiler carryover or condensate and is undesirable, often dangerous, in the operation of engines, turbines, or processes where steam is required. It is in this field that V. D. Anderson Co. has served industry for many years and is preparing to show and explain the fine points of the design of its steam and air traps, oil and moisture expellers, and pipe-line strainers—equipment used to remove unwanted liquids and solids from steam and compressed air pipe lines.

Two new designs of refrigerant gas purgers have been brought out by Armstrong Machine Works and will be on exhibit here along with a glass model of a steam trap which will be operating with steam at a pressure of 5 psi.

One of the puzzling problems often encountered by designers is the means by which liquids, such as cooling water or lubricating oil can be delivered to a moving element. How this may be done will be shown by Barco Mfg. Co. using ball, swivel and roller type joints.

Rather startling developments have taken place in the design and manufacture of gearing which is now being incorporated in power machinery. Some of this will be noted in the exhibit of the Boston Gear Works which will consist of power transmission equipment and machine parts under the slogan "It Pays to Standardize."

Housekeeping is becoming recognized more and more every day as one of the essentials of efficient plant operation and to make the work easy Breuer Electric Mfg. Co., has developed and will display Tornado dust collectors, portable industrial vacuum cleaners, portable electric blowers, electric floor scrubbers and polishers. Blueprint and duplicating machines will also be shown since considerable progress has been made along this line.

Metering Instruments Will Be Shown

Demonstration of the simple "Niagara" single-piston liquid meter will be conducted by Buffalo Meter Co. whose volumetric type of design is applicable for measuring cold water, oils and other non-corrosive liquids. Greater accuracy is continuously being demanded from metering instruments and the latest designs are attractive for their simplicity.

Getting coal or other bulk materials from point of delivery at the plant to the place where it is used is an individual problem confronting nearly every plant and E. W. Bushman Co., Inc., will be at the Show with conveyors, and other materials handling equipment which have general application in power plants and industries.

Fig. 3. Grand Central Palace on Lexington Avenue in New York City is just a short walk from Grand Central Railway Station with several hotels close by

The old hand operated bellows as a dust remover is an antique today, the modern sequel with many more services may be found to be the Clements Mfg. Co's. Cadillac portable electric blower which is designed to operate at two speeds, with vacuum and spray attachments.

Throughout the entire history of engineering, gears have played an essential part in the development of industry and improvements have come year by year as better materials and more exacting manufacturing equipment has been devised. The Cleveland Worm & Gear Co. who shares space with The Farval Corp. has been in the forefront of this development and will exhibit its latest design of Cleveland Speedaire fan cooled worm gear reduction. Farval centralized systems of lubrication and the new Farval automatic pumping unit serving Dualine valves will also be on display.

Maintenance men just don't spend valuable time making crude homemade tools and supplies for keeping their power belts in repair if they can get factory made belt lacers, cutters, hooks and lacing pins like Clipper Belt Lacer Co. will show. Some other products on display will be spindle tape, condenser tape lacing equipment and supplies.

Steam Generator in Operation

Opportunity will be afforded in the booth of the Cyclotherm Corp. to witness a 60 hp, completely self-contained operating steam generator with modulating controls equipped to fire heavy oil, the installation being set up to demonstrate the operation of the company's heavy oil pump set and feedwater pump set.

Among the foremost developments in the field of heat exchangers is a self-containing heat exchanger which cleans while it operates. It will be displayed by Davis Engineering Corp. along with evaporators, distillers, feedwater heaters, process heat exchangers, fuel oil heaters and many new power plant products.

During recent years, V-belts have broadened their range of application tremendously as will be emphasized by the Dayton Rubber Mfg. Co., the manufacturer of Dayton Thoroughbred V-belts.

Water columns, water gages, try cocks, illuminators, gage glasses and gaskets are all details that go to make a boiler safe for the operator and designs have necessarily changed as steam pressures and temperatures have increased, as will be seen when examining the products of Ernst Water Column & Gage Co.

Constant changes in industrial pressure requirements have necessitated the development of and subsequent improvement in liquid level controllers and control valve regulators for use in power plants, chemical process, oil refining, air conditioning and general industry. Fisher Governor Co. will show its products designed for control purposes, one of the new features of which is a diaphragm motor for control valves.

An exhibit is being prepared by the Fluor Corp. to demonstrate how removal of pulsative flow at the source can be effected by means of the Fluor pulsation dampener.

Mechanical packings for power and industrial machinery are among the detail elements of equipment that make success or failure of a machine. These packings must meet the specified conditions of pressure, temperature, resist-

Fig. 4. This general view of the 1940 Power Show is typical of what may be seen at the 17th National Exposition to be held in December this year

ance to acid or oil deterioriation, erosion of shafts or rods, speed of contact surfaces and other specific conditions in the handling of liquids, gases and vapors. Garlock Packing Co. will show their products along this line and explain the new features of the various types.

Instrumentation is one of the continually expanding problems of the power plant engineer, just how far he should go in providing controls and indicating and recording instruments should be answered for each plant. Much help may be had at the booth of Hays Corporation where automatic combustion contral, draft gages, CO_2 recorders, portable gas analyzers and flow meters will be on exhibit. Of particular interest is the new remote reading Veriflow meter which has been developed for measuring, indicating and totalizing various liquids.

Oil Purification

Lubricating problems loom large to the engineer in charge of power equipment maintenance but his difficulties are being lightened continuously as lubricants and their purifying equipment are being perfected. Several advanced developments will be exhibited by Honan-Crane Corp. including "Clean Oil" automatic clarifier and oil purifiers, which will be in operation, equipment designed for complete purification of fuel oil and lubricating oil for Diesels, gas engines, turbines and hydro-electric generators.

Keasbey & Mattison, plans to exhibit "Featherweight" 85% magnesia pipe, block and cement insulation, and asbestos textiles, packings, water pipe ebonized asbestos, and asbestos corrugated sheathing. Products will be dramatized and animated by a revolving turntable unit. Corrugated asbestos of use for industrial roofing and siding and decorative interior effects will be demonstrated by working material into the construction of the display.

New control methods and equipment are required with every change in industrial process and some of the latest designs will be on display by Kieley & Mueller. "Kontrol Motor" diaphragm valves, pressure regulators, pump governors, "Kontrol Master" liquid level control, and strainers for application in distribution of steam, will be included.

Attention to recently developed power transmission machinery will be called by Link-Belt Co. through display of the new Link-Belt electro-fluid and the motorized line of ball and roller bearings. together with a photographic presentation of a complete line of power transmission equipment.

In the field of control equipment, the mercury switch has been used extensively as a positive make and break device for electric circuits, largely because of its immunity to dust, dirt and corrosion and that it operates without open arcing, pitting or sticking of contacts. The Mercoid Corp. makes use of this type of switch in its automatic controls for heating, refrigeration, air conditioning and industrial applications which will be exhibited at the show together with hermetically enclosed mercury contact switches.

In the booth of Metalock Casting Repair Service, will be shown Metalock-process repairs on Diesel engine heads, cylinders, and crankshafts made without welding or use of heat. This new method of repairing cracks has features of advantage well worth consideration by maintenance engineers.

The new 1947 line of unit heaters, convection radiation and heating coils with major design improvements will make up the exhibit of Modine Mfg. Co. Equipment of this type is meeting the space heating needs in many industrial plants.

Many industries have discovered that their processes and products have been improved by properly conditioning the air in their factories. Problems of this kind are being solved by the use of equipment manufactured by the Niagara Blower Co. who will demonstrate the operation of full scale apparatus. The newest item in the company's exhibit will be the "Bantan" model of the Niagara Aero Heat Exchanger with which automatic temperature control of various industrial process liquids is accomplished by evaporative cooling without wasting of condenser water. Niagara Aero steam, gas and refrigerant condensers and gas coolers, as well as equipment for air conditioning, humidification and dehumidification will be on display for inspection.

In the field of lubrication, such equipment as liquid filters, oiling devices, oiling and filtering systems, sight feed valves and flow indicators are helping to maintain the reliability of power machinery. Wm. W. Nugent & Co. will exhibit their products along this line and will also show pressure cellulose fuel and lubricating oil filters for internal combustion engines.

Many new features of bronze, iron and steel valves for the use of industry in general will be on display in the booth of Ohio Injector Co. where modern large steel valves will be in operation.

Fittings for Tubes

Remote control through the use of fluids in tubing has been developing continuously in industry and calling for specially designed tube couplings, fittings and valves made of such metals as aluminum alloy, brass, bronze and steel. These and other related products like bending equipment, compounds, etc., applicable to general industry and certain items of particular interest to power engineers will be featured by Parker Appliance Co.

Instruments and controls have gone a long way toward perfection in details of construction during the war period which demanded high efficiency of combustion. Perfex Corp. will be showing its recent developments along the lines of combustion and draft controls; indicating instruments such as single pointer draft gages, fan pressure gages, and flue-gas temperature indicators.

In addition to steam valves for high and low pressure, boiler-feed valves for a modern steam plant—globe, angle, check, gage, non-return in bronze, iron and steel—The Wm. Powell Co. will feature a new style high-pressure high-temperature welding end steel non-return globe valve embodying new press-steel bonnet construction, compound spur gear operation and large size welded bonnet gage valves.

Application of power to many industrial machines would be greatly handicapped if it were not for such devices as variable speed transmission vari-speed motor pulley, vari-speed motor drive, with hydraulic, electric remote, mechanical and pre-set controls which will be displayed by Reeves Pulley Co.

Among the more recently developed materials for use in power equipment is

a product of Republic Steel Co. which is marketed under the trade name of Electrunite. Its use will be shown in an exhibit of boiler, condenser and heat exchanger tubes, stainless steel tubing and electrical metallic tubing, also light weight conduit. Most interesting will be a demonstration of crush test. A small model of a testing apparatus used on production line will take samples of tubing and establish the soundness of the sample crushed end to end, subject the test piece to more than 100 times the distortion it would undergo if it were installed in a boiler, condenser or heat exchanger.

Steam Pipe Insulation

Saving of heat on its way to perform work is one of the essentials of economy and how this may be done will be shown by Ric-wiL Co. who have arranged to display a model Ric-wiL expansion loop showing actual movement of pipe in the loop to allow for expansion.

Materials and equipment of the latest designs used by maintenance engineers will be found in the booth of John R. Robinson who is featuring Steelbestos gaskets for stationary water tube boilers and treated gaskets for use in marine water tube boilers. CEKO metallic filler for emergency repairs, condenser tube cleaning brushes and gun, and cleaner for gasket surcases. Stuart automatic separators for separating oil and water from compressed air will also be shown.

Much has been learned in recent years about the theory of heat transfer and recent designs of equipment are reflecting these discoveries. In this field Fred H. Schaub Eng. Co. will display a "Heat Reclaiming" system, feedwater, deaerator, Draintrol, combination column—liquid level control, applicable in all industries where pressures over 15 psi are used.

Under the stress of production for war many substitute metals have been tried out experimentally and some have been alloyed to meet specific service. Scovill Mfg Co. has done some outstanding work along this line and will show its new condenser and heat exchanger tubes of use in stationary and marine power plants, chemical and petro-chemical fields. The exhibit will show the effects of various environmental conditions on tube metals.

In many industries liquids must be handled proportionately in order to produce the proper mixture. In this field Sier-Bath Gear Co. has developed and will display screw and Gearex rotary pumps which work admirably for this purpose. They will also show precision cut gears, forms—equipment applicable in power plants, process industries, oil plastic and machine tool fields.

Liquid metering instruments have gone through many changes in details of design during the past few years in order to improve their accuracy and fit them more closely into specific applications as will be noted in the exhibit of R. W. Sparling who plans to display water measuring equipment for lines 2 in. in diameter and above. There will be totalizers, indicators, recorders and controls, compound meters and remote control recorders with 60 day charts.

Housekeeping Equipment

Industrial leaders recognize that a clean place to work is among the most effective morale builders they can supply their workmen. To aid in this direction, Spencer Turbine Co. will display its line of vacuum cleaners and centrifugal type blowers—portable and stationary, applicable in industrial fields and power plants.

Equipment that goes into a power plant must be studied for its applicability to the service it must perform. This fact has been recognized by Strong, Carlisle & Hammond Co. who for years have made steam specialities, of many kinds for industry. Many of these will be on display along with a new line of steam traps. A continuous blow-down valve and assembly in a new application will also be shown.

Recent developments in science have opened up an entirely new world for the designer of instruments to be used by industry and as one of the leaders in this field Taylor Instrument Companies has arranged to display industrial control instruments, new applications of boiler blow-down control and a new design of pulsation dampener.

Welding Fittings

Pipe welding as a method of fabrication was a long time in being developed to the point where it had the approval of all engineers. Tube Turns, Inc. was one of the pioneers in the development of this art when they provided the industry with welding fittings and flanges which are now made of a variety of metals used for piping steam, water and other industrial fluids. These will be shown in their latest designs.

Nothing is more aggravating to an engineer than a leak in a joint that is supposed to be sealed tight. Solutions to such problems are continuously changing with changing industrial requirements and new materials available for use. Some of the answers to the problems will be found at the booth of the United States Gasket Co. where Ajax spiral wound boiler and flange gaskets will be shown along with a general line of industrial gaskets.

When specifying equipment for a piping system it is essential to consider the service under which it is to be operated. The Henry Vogt Machine Co. has studied the various applications of piping and will display a complete line of valves, fittings and flanges, for oil, steam, water, gas and ammonia services, at high and low pressures and temperatures.

Just one of the details of construction, one would say of the compressor valves and valve discs made and to be exhibited by J. H. H. Voss Co., Inc., for use in air, ammonia and gas compressors, but it is such details that make a success or failure out of an important piece of equipment. They will be worth examining carefully.

Not long ago the recognized best means for cleaning condensers was the tube cleaner. Study of the formation of the heat insulating slime that collects in these tubes suggested that killing the organisms that have a tendency to grow there would enable the surface to be washed clean by the condensing water thus saving a lot of work and improving heat transfer. This problem was attacked by Wallace & Tiernan Products, Inc., who developed the chlorinating equipment for condenser and heat ex-

Fig. 5. Engineers at the Power Show study seriously equipment on display

changer desliming which will be on display along with precision pressure sensitive instruments.

In the list which follows is given the names of all exhibitors who had reserved space at the Show at the time of going to press with this issue. Only a small portion of the exhibits are covered in the preceding paragraphs since advance information on others was not available. The reader, however, may judge from the descripitions given here that the Show will be an exhibit and demonstration of the latest designs of manufactured equipment, processes and materials made available to the public for the economical generation and utilization of power.

Exhibitors

17th Exposition of Power and Mechanical Engineering

Grand Central Palace—New York, December 2-7, 1946

A.S.M.E., Mechanical Catalog & Directory, New York, N. Y.
Abrams, Inc., Morris, New York, N. Y.
Aerotec Co., White Plains, N. Y.
Air Hydraulics, Inc., New York, N. Y.
Aldrich Pump Co., The, Allentown, Pa.
Allen-Bradley Co., Milwaukee, Wis.
Allen-Sherman-Hoff Co., Philadelphia, Pa.
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
Alten's Foundry & Machine Works, Lancaster, Pa.
American Artisan, Chicago, Ill.
American Blower Corp., Detroit, Mich.
American Brass Co., The, Waterbury, Conn.
American Chain & Cable Co., Inc., Reading, Pratt & Cady Div., Bridgeport, Conn.
American Chain & Cable Co., Inc., Wright Mfg. Div., Bridgeport, Conn.
American Gas Association, Inc., New York, N. Y.
American Gas Furnace Co., Elizabeth, N. J.
American Leather Belting Association, Inc., New York, N. Y.
American Metal Hose Branch, The Amercan Brass Co., Waterbury, Conn.
The American Rolling Mill Co., Middletown, O.
American Saw Mill Machinery Co., Hackettstown, N. J.
American Society of Mechanical Engineers, New York, N. Y.
Ames Iron Works, Oswego, N. Y.
Ampco Metal, Inc., Milwaukee, Wis.
G. H. Anderson & Co., New York, N. Y.
The V. D. Anderson Co., Cleveland, O.
Armor-Clad Co., Newark, N. J.
Armstrong Machine Works, Three Rivers, Mich.
Armstrong Steam Trap Co., Three Rivers, Mich.
Atlantic Gear Works, Inc., New York, N. Y.
Atlas Press Co., New York, N. Y.
Aurora Equipment Co., New York, N. Y.
Automatic Switch Co., New York, N. Y.
Automatic Transportation Co., Chicago, Ill.
Bailey Meter Co., Cleveland, O.
Baldwin Belting, Inc., New York, N. Y.
Barco Mfg. Co., Chicago, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bayer Co., St. Louis, Mo.
Belco Industrial Equipment Div., Paterson, N. J.
Benjamin Electric Mfg. Co., Des Plaines, Ill.
James B. Biddle Co., Philadelphia, Pa.
Blackburn-Smith Mfg. Co., Inc., Hoboken, N. J.
Black-Sivalls & Bryson, Inc., Kansas City, Mo.
Blaw-Knox Co., Power Piping Div., Pittsburgh, Pa.
Charles Bond Co., Philadelphia, Pa.
Boston Gear Works, Inc., North Quincy, Mass.
Breuer Electric Mfg. Co., Chicago, Ill.
Brickseal Refractory Co., Hoboken, N. J.
Bridgeport Brass Co., Bridgeport, Conn.
Bristol Co., The, Waterbury, Conn.
Brown Instrument Co., The, Philadelphia, Pa.
Bruning, Charles Co., Inc., Chicago, Ill.
Bryant Heater Co., Cleveland, O.
Buell Engineering Co., Inc., New York, N. Y.
Buffalo Caster & Wheel Corp., Buffalo, N. Y.
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Builders-Providence, Inc., Providence, R. I.
Buschman, E. W. Co., Inc., The, Cincinnati, O.
C. & N. Mfg. Co., Saybrook, Conn.
Cambridge Instrument Co., Inc., New York, N. Y.
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Cleveland Worm & Gear Co., The, Cleveland, O.
Clinton Machine Co., Clinton, Mass.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Coaltoter Conveyor Co., Chicago, Ill.
Cochrane Corp, North Philadelphia, Pa.
Coen Company, New York, N. Y.
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Condenser Service & Engineering Co., Inc., Hoboken, N. J.
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Conover-Mast Publications, New York, N. Y.
Consolidation Coal Co., Pittsburgh, Pa.
Continental Gin Co., Birmingham, Ala.
Corning Glass Works, Corning, N. Y.
Coxhead Corp., Ralph C., New York., N. Y.
Cramer Co., Inc., R. W., The, Centerbrook, Conn.
Crane Co., Chicago, Ill.
Crystal Lake Grinders, Crystal Lake, Ill.
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Dampney Co. of America, The, Hyde Park, Boston, Mass.
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DeLaval Steam Turbine Co., Trenton, N. J.
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Eagle-Picher Sales Co., The, Cincinnati, O.
Eagle Signal Corp., Moline, Ill.
Eastern Steam Specialty Co., New York, N. Y.
Eastern Tool Supply Co., New York, N. Y.
Edge Moor Iron Works, Inc., Edge Moor, Del.
Edward Valves, Inc., East Chicago, Ind.
Elastic Stop Nut Corp. of America, Union, N. J.
Electro-Tech Equipment Co., New York, N. Y.
Ellison Draft Gage Co., Chicago, Ill.
Energy Control Co., Inc., New York, N. Y.
Eriez Mfg Co., Erie, Pa.
Ernst Water Column & Gage Co., Livingston, N. J.
Ess Instrument Co., Bergenfield, N. J.
Eutectic Welding Alloys Corp., New York, N. Y.
Everlasting Valve Co., Jersey City, N. J.
Fairbanks Co., The, New York, N. Y.
Fairbanks-Morse Co., New York, N. Y.
Fairfield Engineering Co., The, Marion, O.
Falstrom Co., Passaic, N. J.
Farval Corp., The, Cleveland, O.
Faultless Caster Co., Evansville, Ind.
Feedrail Corp., New York, N. Y.

(*Continued on page 118*)

Fig. 6. Seeing the Show is advanced education to many who linger at the booths to ask for information

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Keeps Rings Free in Big Diesels for More than One Year of Continuous Operation

More than a year of continuous running, day and night . . . no stuck rings . . . no heavy sludge . . . no hard carbon . . . that's the record of a "Job-Proved" Sun Diesel lubricant in a big industrial power house.

The picture above shows a piston from one of the company's two 750-h.p., 6-cylinder, 4-cycle, Worthington Diesels after 9,000 hours of operation. The engine was shut down at this time only for routine inspection.

Performance like this is typical of the results being obtained by hundreds of Diesel operators in plants throughout the country, and in all types and sizes of Diesel.

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(*Continued from page 116*)

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Fisher Governor Co., Marshalltown, Iowa
Fisher Tool Co., New York, N. Y.
Flexitallic Gasket Co., Camden, N. Y.
Fluor Corp., Ltd., The, Los Angeles, Calif.
Foley Mfg. Co., Minneapolis, Minn.
Foote Bros. Gear & Machine Corp., Chicago, Ill.
Foster Engineering Co., Newark, N. J.
Foxboro Co., The, Foxboro, Mass.
Furnas Electric Co., Inc., Batavia, Ill.
Garlock Packing Co., The, Palmyra, N. Y.
Gates Rubber Co., The, Denver, Colo.
Gehnrich & Gehnrich, Inc., Woodside, N. Y.
General Aniline & Film Corp. Ozalid Division, Johnson City, N. Y.
General Chain & Belt Co., New York, N. Y.
Gordon Co., James T., New York, N. Y.
Graham Transmission, Inc., Milwaukee, Wis.
P. E. Greene, Newark, N. Y.
Grinnell Co., Inc., Providence, R. I.
Griscom-Russell Co., The, New York, N. Y.
Grossman Co., David, R., New York, N. Y.
Gulf Oil Corp., Pittsburgh, Pa.
Hahn Equipment Corp., New York, N. Y.
Hamilton Mfg. Co., Two Rivers, Wis.
Hansen & Yorke, Inc., New York, N. Y.
Hardinge Co., York, Pa.
Hays Corporation, Michigan City, Ind.
Heating, Piping & Air Conditioning, Chicago, Ill.
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Hein, Louis H., Co., Ardmore, Pa.
Homestead Valve Mfg. Co., Inc., Coraopolis, Pa.
Honan-Crane Corp., Subsidiary, Houdaille-Hershey Corp., Newark, N. Y.
Hones, Inc., Charles K., Baldwin, N. Y.
Howell Electric Motors Co., Howell, Mich.
Hyster Co., Peoria, Ill.
Ideal Industries, Inc., Sycamore, Ill.
Independent Pneumatic Tool Co., Chicago, Ill.
Industry and Power, Maujer Publishing Co., St. Joseph, Mich.
Ingersoll-Rand Co., New York, N. Y.
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International Nickel Co., New York, N. Y.
Ironbound Box & Lumber Co., Hillsdale, N. J.
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Janney Cylinder Co., Philadelphia, Pa.
Jenkins Bros., New York, N. Y.
Jerguson Gage and Valve Co., Somerville, Mass.
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Johnson Corp., The, Three Rivers, Mich.
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Keuffel & Esser Co., New York, N. Y.
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Lonergan Co., J. E., Philadelphia, Pa.
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McGraw-Hill Publishing Co., New York, N.Y.
Machine Tool Sales, New York, N. Y.
P. E. Madden & Co., Chicago, Ill.
Magnetrol, Inc., Chicago, Ill.
Mall Tool Co., Chicago, Ill.
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Marlo Co., The, New York, N. Y.
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Metalock Casting Repair Service, Long Island, City N. Y.
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Modine Mfg. Co., Racine, Wis.
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Moore Co., J. Arthur, New York, N. Y.
Munton Mfg. Co., Franklin Park, Ill.
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National Association of Power Engineers, The, Detroit, Mich.
National Engineer, Detroit, Mich.
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Ohio Injector Co., Wadsworth, O.
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Olsen Testing Machine Co., Tinius, Philadelphia, Pa.
Omega Machine Co., Chicago, Ill.
Owens-Corning Fiberglas Corp., Toledo, O.
Ozalid Division General Aniline & Film Corp., Johnson City, N. Y.
Packless Metal Products Corp., New Rochelle, N. Y.
Pallet Sales Co., New York, N. Y.
Palmer Co., The, Cincinnati, O.
Paragon-Revolute Corp., Rochester, N. Y.
Parker Appliance Co., The, Cleveland, O.
Partlow Corp., The, New Hartford, N. Y.
Patron Transmission Co., New York, N. Y.
Paulson & Son., Inc., Thomas, Brooklyn, N.Y.
Pease Co., The C. F., Chicago, Ill.
Penn Industrial Instrument Co., Philadelphia, Pa.
Pennsylvania Flexible Metallic Tubing Co., Philadelphia, Pa.
Perfecting Service Co., Chicago, Ill.
Perfex Corp., Milwaukee, Wis.
Perolin Co. of New York, New York, N. Y.
Phelps Co., Charles C., New York, N. Y.
Philadelphia Gear Works, Inc., Philadelphia, Pa.
Photoswitch Inc., Cambridge, Mass.
Pneumatics, Inc., Plymouth, Ind.
Porter-Cable Machine Co., The, Syracuse, N. Y.
Powell Co., The Wm., Cincinnati, O.
Power, New York, N. Y.
Power King Tool Corp., New York, N. Y.
Power Piping Div., Blaw Knox Co., Pittsburgh, Pa.
Power Plant Engineering, Chicago, Ill.
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Proportioneers, Inc., Providence, R. I.
Purchasing, New York, N. Y.
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Rack Engineering Co., Pittsburgh, Pa.
Rampell, A. S., Brooklyn, N. Y.
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Reeves Pulley Co. of N. Y., Inc., New York, N. Y.
Reiner Machinery Corp., New York, N. Y.
Reintjes Co., Geo. P., Kansas City, Mo.
Republic Flow Meters Co., Chicago, Ill.
Republic Steel Corp., Steel & Tubes Div., Cleveland, O.
Revere Copper and Brass, Inc., New York, N. Y.
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Rhoads & Sons, J. E., Philadelphia, Pa.
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Ric-wiL Co., The, Cleveland, O.
Ridge Tool Co., The, Elyria, O.
Robinson, John R., New York, N. Y.
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Sandersen Sales Service, New Haven, Conn.
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Sheldon Machine Co., Inc., Chicago, Ill.
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Steel-Parts Mfg. Co., Chicago, Ill.
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Taylor Instrument Companies, Rochester, N.Y.
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Voss Co., J. H. H., New York, N. Y.
Waite Construction Co., Providence, R. I.
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Walker-Turner Co., Inc., Plainfield, N. J.
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Watson-Stillman Co., The, Roselle, N. J.
Wells Sales Co., J. G., New York, N. Y.
West Bend Equipment Corp., West Bend, Wis.
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Proper water treatment consists of something more than adding chemicals to a boiler system. All aspects of the problem must be considered, including Boiler Design, Operation, Application and Control, as well as the actual chemical treatment itself. There is no "cure-all" for water problems . . . Bird-Archer's 60 years of experience has established that fact.

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Safe Boiler Operation

Discussion of factors influencing safe operation of power boilers not found in customary operating instructions, manuals, codes . . . Causes of boiler accidents fall in three distinct groups: failure of the human element; errors in design and construction; wear and tear . . . Detailed suggestion for improving safety records . . . Competent operators, experienced designers and manufacturers, a sensible inspection and maintenance program are vital

By MAX H. KUHNER
Chief Mechanical Engineer, Riley Stoker Corp.

OPERATING MANUALS, printed instructions for the boiler operating engineer, ASME Suggested Rules for Care of Power Boilers, and various other publications cover the subject of safe practices in steam boiler operation in considerable detail. Therefore no attempt is made in these pages to discuss procedures which are expected to be common knowledge by the experienced boiler operating personnel. Men in charge of the boilers should take full advantage of the information found in such literature. It is based on the combined experience and knowledge of a group of men qualified in the fields of operation, construction and design. Many boiler operating troubles will be prevented if the printed rules are known and followed.

There are, however, many other factors not mentioned in printed manuals, but of equally great importance for the safe performance of the boiler. Unless these factors are known and well understood they can become the cause of serious boiler accidents.

The files of boiler insurance companies are filled with case histories of such accidents. Many reports show that in spite of the most conscientious efforts to find the cause it was not always possible to determine the why and how of the accident. Very often the evidence was destroyed by explosion and fire and in many cases the only witness did not live to tell. Fortunately there are many more for which it was possible to establish blame so clearly that these cases can be made to serve as examples of what not to do. They fall in three distinct groups.

The Human Element

The first group, by far the largest, contains those boiler accidents caused by failure of the human element. These are accidents which should never have happened. They were caused by lack of clear thinking, by inexperience, carelessness, bad habits and just plain ignorance.

There is only one way to prevent or at least reduce the number of these accidents, that is, careful selection of the personnel entrusted with the boiler and thorough training of these men. Apprentice boiler operators must be made to understand that the primary object of their studies and practical training is not the license issued by an examining board certifying in black and white that in the board's opinion the individual is qualified to operate boilers. It is rather to obtain knowledge and understanding of the workings of a boiler, to know what is going on in drums and tubes and furnace, to realize which factors affect safe and reliable performance. The boiler operator must be made conscious of the importance of his job by realizing that the safety of his co-workers and of costly equipment depends on his doing the right thing at the right time.

Most important for the safe performance of his job is thorough familiarity with the design and the detailed construction of the equipment in his charge. No part of the boiler must remain a mystery. Strong and weak points of the boiler must be known. In this way a measure of confidence will be established without which the operator would be unable to get the best out of his equipment under the varying operating conditions of the boiler house. The competent operating engineer makes a habit of occasionally checking his natural reflexes. He will want to know what first step he will take in case of an emergency.

Warren D. Lewis, chief engineer of the Hotel New Yorker, gave this apt specification: "The good operating engineer doesn't lose his head. Assuming that he knows his plant and his business he must learn by experience to sit tight and think things out when he finds himself in a jam. Nothing is more costly than a wrong answer put into action because it was the first that came to mind when the heat came on."

The Wrong Answer in Action

One operator's experience with a large pulverized-coal-fired boiler is a good illustration of the disastrous results possible by "putting the wrong answer into action." The boiler had a slag tap furnace with the furnace floor covered by a pool of molten ash, which was intermittently tapped off. One morning, while the manufacturer's plant was going at full capacity, a house turbine accidentally tripped, temporarily shutting off the power supply to motors of fans and pulverizers.

When the boiler operator in charge noted the drop in steam pressure and found the pulverized coal burners dead, he could not take the time to think. His natural reflex forced him to act quickly and his entire effort was concentrated on keeping the boiler on the line. There were steam atomizing oil burners for starting up and to carry low loads. All he thought to do was to turn on the oil. Unfortunately he forgot to open the valve for the atomizing steam and he had not taken the time to check draft gages so that he was unaware that the fans had stopped running. The oil burners would not ignite, but solid streams of oil poured on the pool of molten ash on the furnace floor. The oil vaporized . . . .

When the operator picked himself off the boiler room floor, and after the boiler house atmosphere had sufficiently cleared for him to see, it was found that the boiler casing was badly bulged and the heavy steel reinforcing members of the setting were bent out of shape, but the operator found himself alive and in one piece. The steel boiler casing withstood the explosion and confined the damage to the boiler setting.

It cost only 30,000 pre-war dollars to repair the damage and to return the boiler to operating condition. The boiler insurance company paid for this damage, but loss of production during the outage of the main boiler of this manufacturing plant was many times $30,000, and there was no way to recover this loss.

The operating engineer was a capable man. He had passed the examination of the licensing board with flying colors. He knew his boiler inside and out. He was able to get the best out of it in day-in and day-out operation, but when "the heat came on" he fell down on his job. His training lacked that part that makes a man sit tight and think things out before jumping into action.

Errors in Design and Construction

The second group is smaller and consists of those accidents which were the result of misjudgment of the designer and manufacturer of the boiler. Most of these failures could have been prevented by more sensible design, but hindsight is so much more effective than foresight. When the design is original and enters an untried field it may be excusable if its first execution is not completely successful. Progress in the art of steam generation required some measure of pioneering. There are, however, common errors that are repeated time and time again. The following are a few examples:

Probably the most popular mistake made in boiler design is lack of provision for unrestricted natural circulation. Some boiler and water wall tubes produce steam at rates as high as 40 lbs per sq ft per hour. Steam must

---

Presented at Boiler and Pressure Vessels Subject Sessions of ASSE, 34th National Safety Congress, Chicago, October, 1946.

See also Safety in Power, by Max H. Kuhner; *Safety Engineering*, Vol. 92, No. 1, July 1946, page 14.

Two Simple Inventions Offer Important Economies In Condenser Operation

New Fiberclad* Flowrite tube inserts stop condenser tube end erosion, seal tube leaks, prolong life of old tubes, and reduce water friction up to 80%.

New Detectaleak* Tube Tester instantly locates leaking tubes without necessity of dismantling condenser.

*PATENT PENDING

FOR over 20 years millions of Flowrites, metal belled-end tube inserts, have been used successfully to protect condenser tube inlet ends against erosion and to eliminate expensive shutdowns for tube replacement. A new type insert, called Fibreclad Flowrite, offers many important advantages over other types previously available.

The Fibreclad Flowrite consists of a belled-end unbreakable metal tube, similar to the old Flowrite, with a very thin fibre sleeve shrunk on the outside, as shown in Fig. 2. Installation is very simple, and requires no cement, no special care. After installation, the fibre swells when in contact with water, producing a very tight seal which prevents leakage, even through tubes eroded like those shown in Fig. 1.

The peculiar shape of Fibreclad Flowrites provides a perfect venturi which reduces water friction up to 80%, according to tests conducted at M. I. T.

Fiberclad Flowrites are available for any size tube, in lengths to suit the erosion problem of the particular unit for which they are ordered.

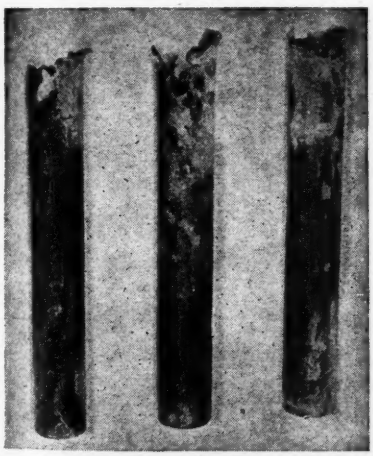


Fig. 1—Three badly eroded condenser tubes cut out of a unit to show condition of tubes which Fibreclad Flowrites can salvage for further service

Detectaleak Tube Tester

Anyone who has gone through the tedious, time-consuming process of weeding out leaking condenser tubes will appreciate a newly invented simple tool called Detectaleak Tube Tester. With this tool leaking tubes can be located instantly without dismantling the condenser.

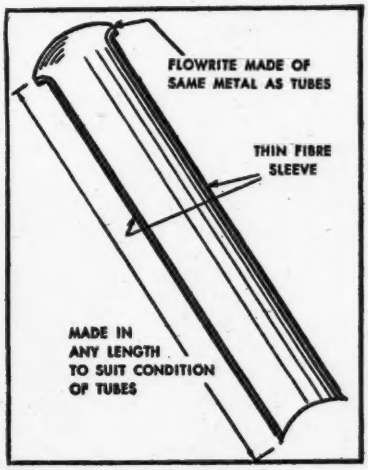


Fig. 2—Cross section of Fibreclad Flowrite showing new fibre sleeve feature

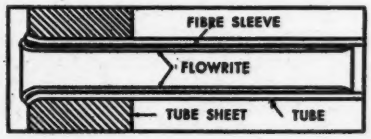


Fig. 3—Fibreclad Flowrites can be used with any type of tube joint

The Detectaleak Tube Tester consists of a rubber body, one end of which is conical to fit into the tube, and the other end is a thin-walled bulb. An air passage connects the bulb with the conical end. A knurled metal sleeve surrounds the body to provide a grip for the hand.

Fig. 4—Detectaleak Tube Tester which instantly indicates a leaking condenser tube

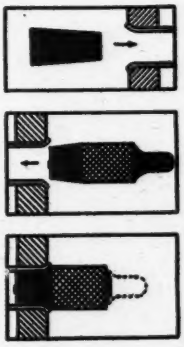
The illustrations show the simple, effective operation of the Detectaleak Tube Tester.

1—With condenser out of service, maintain vacuum in steam space with condenser steam jets.

2—Plug one end of tubes with fibre plugs.

3—Insert Detectaleak Tube Testers in other end of tubes.

4—If Detectaleak bulb is sucked in, tube leaks. Each penetrated tube is located quickly, positively.



The service crew of Condenser Service & Engineering Co., Inc., will conduct tests when you take your condenser out of service over the weekend, or any other time. The Detectaleak Tube Tester is one of many special tools developed by us to save time and labor. You can enjoy the fast, economical service of our highly-trained specialists any time of day or night, anywhere on the continent. All necessary materials are in stock. A wire or phone call will get your job started at once.

For complete details of Fibreclad Flowrites and Detectaleak Tube Testers write, wire or phone

CONDENSER SERVICE & ENGINEERING CO., INC., 69 River Street, HOBOKEN, N. J.

Designers and Manufacturers of

Chemical Processing Equipment
Steam Boilers
Steam Condensers
Steam Jet Air Ejectors
Evaporators
Stage Heaters
Gas Coolers
Drain Coolers and Heaters
Aftercoolers
Air Preheaters
Fuel Oil Heaters
Jacket Water Coolers
Process Heat Exchangers
Transformer Oil Coolers
Generator Air Coolers
Lubricating Oil Coolers
Storage Tank Oil Heaters
Feed Water Heaters
Distillers
Filters
Industrial and Oil Refinery Heat Exchangers
And other types of heat exchange equipment

be swept away from the inside tube walls as quickly as it is formed and must be replaced by water, otherwise the tube will overheat and fail. Only if it is made possible for water to flow through the circulatory system of the boiler and water walls with a minimum of resistance and for the steam to release itself quickly without binding in tubes, will the natural circulation be maintained at velocities necessary to keep the tubes cool. Too often the design of the boiler and water wall system contains restrictions in the path of water and steam so that the force producing natural circulation is used to overcome obstructions and circulation slows down, stops or may flow in reverse direction to that intended. Safe boilers are designed with liberal areas of the feeders supplying water to steaming tubes and of the connections between steaming tubes and drums.

Insufficient capacity of feeders supplying water to water wall systems and of releasers conducting the steam-water mixture from water walls to the steam release drum not only results in circulation troubles and water wall tube losses, but also lack of lively circulation in the water wall system may permit precipitation of suspended boiler water solids in the low points of the system and the resulting accumulation of sludge and mud may still further obstruct the path of circulation. The blowdown valves of some early water wall systems were padlocked so that they could not be operated with the boiler in service. It was found that the water supply to water walls was so critical that tube losses were experienced whenever an attempt was made to use the water wall blowdowns with the boiler under load.

The operator had his choice of either using the blowdown valves to periodically remove the sediment but in so doing losing tubes from insufficient water supply, or keeping the blowdown valves shut and letting mud and sludge accumulate but losing water wall tubes by obstructing free circulation. The failure of a boiler or water wall tube is in itself only a minor calamity, but a tube failure often results in a serious furnace or gas-pass explosion. In any event, a burst tube shuts the boiler down and may in turn cause costly production losses.

There are many boilers in which the steam release drums are too small and in which steaming tubes enter the steam release drum below the working level. The steam must thus find its way through a body of water before it can leave the boiler. This may produce a dangerous condition for piping, engines and turbines; because a sudden load change may throw a heavy slug of water into the steam line.

Influence of Drum Wall Thickness

Another point of potential danger to personnel and equipment, which must be laid on the designers doorstep, is pressure vessels of considerable wall thickness exposed to high temperature. It is, of course, argued that one of the oldest types of boilers, the horizontal return tubular boiler, has its drum shell directly exposed to the furnace, to radiant heat and live flame. But it must not be forgotten that the HRT boiler shell is comparatively thin. This boiler is not used for high pressures and the drum shell thickness is not determined by tube hole ligament efficiency, as is the case with a water tube boiler. Just the same, bagged drum shells caused by overheating are not unusual with HRT boilers.

Exposing the drums of a high-pressure water tube boiler to furnace heat and live flame is dangerous. Even if there is no evidence of weakness during the first few years of operation it must be realized that the outer skin of the drum plate may be overheated while the inner skin remains at boiler water temperature (as long as the surface is clean). The temperature difference between outer and inner skins of the drum plate may be more than 1000 F and, if it is realized that every fiber of the metal in the outer skin is trying to expand several times as much as the metal fiber in the inner skin, it does not require much imagination to foresee the eventual destruction of the metal and the possibility of a disastrous drum explosion. Unfortunately this can happen without prior warning, because the change in metal structure will usually be detected by microscopic examination only.

Dangers from Ash and Slag

Pulverized coal furnaces for large modern boilers are often quite high. There are some which could house a 6-story building with room to spare. If ash and slag are given an opportunity to find a foothold along furnace walls, they will stick and may form clinkers unless the operating engineers are on their toes and continuously poke and lance. Here again the designer should be taken to task for permitting ledges and projections on furnace walls on which ash and slag can lodge. It is dangerous even with a cold boiler. Maintenance men have often been injured by falling slag when it was necessary to enter the furnace of a coal fired boiler for inspection or maintenance!

Some years ago a number of floor screen tubes of a pulverized coal fired boiler tore out of the headers into which they were rolled. The steam and hot water suddenly released into the boiler room killed two of the operators and sent two more to the hospital. The furnace of this boiler was some 35 ft high. A heavy clinker had formed in the upper regions of the furnace and with a change in load broke loose and hit the floor screen.

A screen of tubes laid across the bottom of the pulverized coal furnace is a nice thing to have because pulverized coal ash can sift through this screen and become chilled while it drops into the ash hopper, but when the furnace is high and when there is a possibility for ash and slag to accumulate a considerable distance above the floor screen, then there is danger. Maybe the operators should have noticed that the slag on furnace walls approached dangerous proportions and should have done something about it, but the capable designer knows that his product must be safe even without the complete cooperation of the men to whom it is entrusted.

It may be true that a simple screen of tubes crossing the furnace floor is less costly than a hoppered furnace floor consisting of steeply sloped tubes, supported over their entire length, but no amount of money saved in first cost will justify gambling with safety.

Fortunately accidents caused by faulty design are diminishing. This is in spite of new designs of steam boilers, higher operating pressures and steam temperatures and greater work done per unit of heating surface. Design and construction engineers are rapidly learning their lessons from the earlier experiences.

Failures from Wear and Tear

Boiler accidents caused purely by wear and tear of equipment in service comprise the smallest group. It is true that boilers cannot live forever, but there are few cases on record of accidents caused by the disintegration of boiler metal. The useful life of a boiler is usually governed by obsolescence rather than by general breakdown.

The boiler inspector of State and insurance companies deserves much credit for the maintenance of safety over the entire life of a boiler. A thorough periodic inspection by a man who knows what to look for and who has the authority to recommend improvements or, in extreme cases, condemn, is the best assurance against accidents falling in this group.

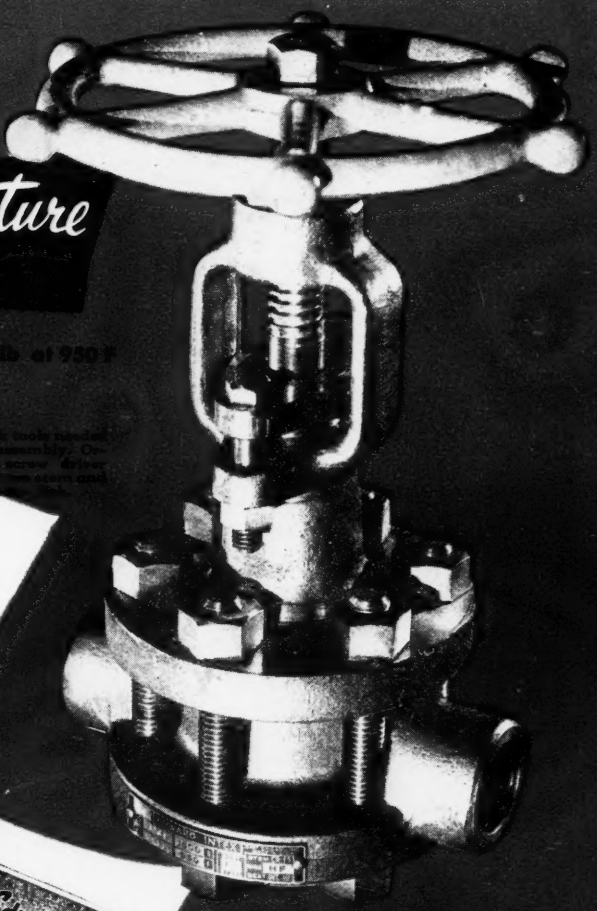
The line of demarcation between failures produced by faulty design and those caused by breakdown in metal is none too distinct. Often the latter is blamed for trouble actually originated by the former. So-called "caustic embrittlement" is an example. Destruction of the metal will happen and did happen in highly stressed points of a boiler drum which are exposed to concentrated causticity. A few years ago it became quite the fad to label every crack found in riveted seams of a boiler drum as "caustic embrittlement."

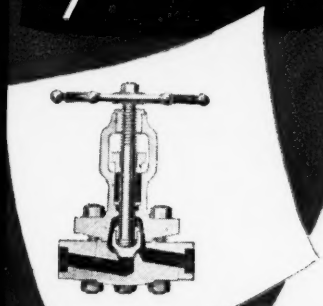
The real trouble was often not a matter of chemistry at all. It was simply metal stressed beyond its elastic limit. The tremendous force exerted by large diameter rivets while shrinking after they were hot formed, compressed the metal under rivet heads to a point where its grain structure was destroyed. Cracks developed and would have developed whether there was caustic concentration or not. These cases of failures belong in the second group. They are the result of error in design.

Competent operators, experienced designers and manufacturers and persistent adherence to a sensible inspection and maintenance program are three factors of equal importance for safe steam boiler operation as are the procedures prescribed in the printed manuals and in the examination papers of boiler operator licensing boards.

WHY EDWARD INTEX VALVES ARE SPECIFIED for THE MAJORITY* OF *top Pressure-Temperature Jobs*

Rating: 1500 lb at 950 F





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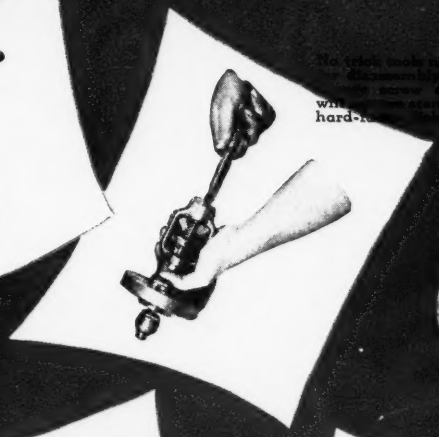
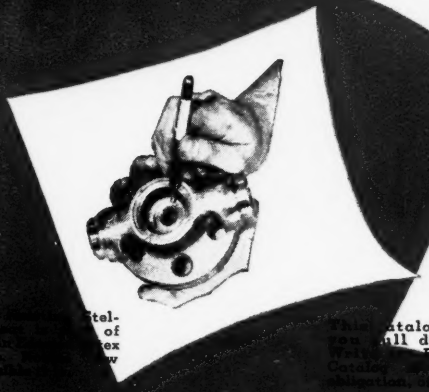


No trick tools needed disassembly. Or screw driver wh stem and hard-f



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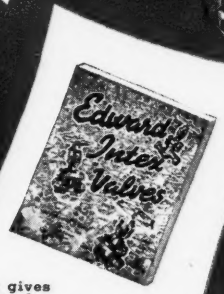


This catalog gives you ll details. Edward No obligation.

If, for your top perature-pres you war instead of bonnet valve, look into the advantages of the Edward Univalve design. Write for de-tails.

Regardless of pressure and temperature, there are always services on which many operators insist on a bolted bonnet valve. For these jobs, Edward Intex valves are specified in a big majority of cases.

The hard faced seat is integral with the body, and the disk is also faced with erosion-fighting Stellite. Maintenance, though seldom necessary, is unusually simple. No special tools are needed for disassembly and the body and bonnet join just above the seat line, where all working parts are easily accessible. No modern valve is easier to relap.

Available in socket welding, screwed or flanged ends from ¼ in. to 2 in., Intex valves are rated at 1800 lb. at 950 F. but are equally trouble-free and economical in intermediate service.

Reflecting that all three types have some advantages, Edward builds bolted bonnet, welded bonnet and pressure sealed bonnet valves for high temperature service.

*Based on a recent survey by an industry magazine.

DELIVERIES FROM STOCK!

Many Sizes

Edward Valves, Inc.

SUBSIDIARY OF ROCKWELL MANUFACTURING CO. EAST CHICAGO, INDIANA

"Intex" is a registered trade mark of Edward Valves, Inc.

NEWS *from* THE FIELD

COAL STORAGE STUDY

SUB-BITUMINOUS COAL can be stored successfully in open pits with negligible loss of heating value if precautions are taken to minimize entrance and circulation of air, according to a publication recently released by the Bureau of Mines. The report is based on results of four years of study made at sub-bituminous coal storage sites of the Great Western Sugar Co. and contains details of coal-storing techniques, together with gas analyses, changes in physical and chemical properties, temperature tables and pit construction data.

Six methods of storing the coal were investigated by the Bureau: in sealed air-tight bins or bunkers, in large formed piles with the sides and top sealed with asphaltic compounds, above-ground in coned piles with water-cooling sprays, underwater storage, surface storage with the coal mass compacted in layers and covered with fine coal, and dry, open-pit storage with the coal compacted in layers. The dry, open-pit method proved to be the most satisfactory for other than very large consumers. It is more economical, permits practical handling of large quantities, allows for periodic removal.

Copies of Report of Investigations 3915, "Storage of Sub-bituminous Slack Coal in Open Pits" are available free of charge from the Bureau of Mines, U. S. Department of the Interior, Washington 25, D.C.

GROWTH OF ELECTRIC POWER

ACCORDING TO a report recently issued by the Edison Electric Institute, 1,070,000 new residential and farm customers were added by the electric power industry in the United States during the first eight months of 1946, despite the housing shortage and difficulties encountered in securing materials and equipment. Data received from power systems throughout the country show that for the 12 month period after V-J Day, 1,668.000 new customers of all classes were added to power lines. This increase represents almost exactly the total number of customers connected to the lines during the first 25 years of the industry's growth.

The greatest rate of gain has occurred since the first of the year and if the present rate of 135,000 homes and farms connected per month continues throughout the year, the 1,600,000 new customers who will be added in 1946 will represent an all-time record. According to the Institute, the majority of the new customers have been added in rural areas.

INSTRUMENT SOCIETY OFFICERS NAMED

THE FIRST NATIONAL Instrumentation Conference and Exhibit at the William Penn Hotel in Pittsburgh, September 16-20, closed with a registration of about 4,000. The Instrument Society of America installed its new officers on Wednesday evening: C. O. Fairchild, President; Cary Kayan, First Vice-President; H. Barnum, Vice-President; J. B. McMahon, Vice-President; Ralph Munch, Vice-President; Hugh Ferguson, Treasurer; and Richard Rimbach, Executive Secretary.

Plans are already started for the next Conference and Exhibit at the Stevens Hotel, Chicago, the week of September 8th. The exhibit floor plan will be sent out shortly.

HOME LIGHTING PROMOTION BY UTILITIES

HOME LIGHTING will be aggressively promoted during 1947 by more electric utility companies than was ever the case in any prewar period, with home lighting advisory services, promotion through dealers and extensive local advertising of the new certified lighting equipment playing leading parts, it is disclosed in a survey of the industry's plans for lighting promotion just released by the Home Lighting Committee, Commercial Division, Edison Electric Institute. The survey, which includes reports from eighty-seven companies serving 48.3 per cent of the total residential and farm customers of the U. S., is entitled "Utility Home Lighting Education, 1946-47."

ASME NAMES HONORS RECIPIENTS

THE AMERICAN Society of Mechanical Engineers has made public the names of those selected to receive its 1946 honors and awards which are to be presented at the Society's annual meeting.

The ASME medal, the Society's highest honor, awarded annually for distinguished service in engineering and science, will go to Morris Evans Leeds, Leeds and Northrup Co.

The Holley Medal, presented for "some great and unique act of genius of an engineering nature," will go to Norman Rothwell Gibson, Buffalo Niagara Electric Corp.

The Melville Prize Medal, for an original paper on mechanical engineering, will go to Troels Warming, Port Washington, Wis., for his paper, "Polar Diagrams for Tuning of Exhaust Pipes." The Junior Award for the best paper by a junior member of the ASME will be presented to Martin Goland, Kansas City, Mo.

The Guggenheim Medal, while not exclusively an ASME honor, will be presented at the same time as the other awards. This medal will be presented to Air Commodore Frank Whittle of the Royal Air Force, Great Britain.

Two awards will be made at the student luncheon. The Charles T. Main Award, given to a student member of the ASME for a paper on the general subject of the influence of engineering upon public life, will be presented to Victor S. Rykwalder, Victor Chemical Co. The Undergraduate Student Award will go to Paul A. Thompson, Illinois Institute of Technology.

Two honorary memberships will be conferred; they will go to Alexander Graham Christie and Louis Ketcham Sillcox.

NEW FILM ADVISORY SERVICE

OFFERING A film advisory service to manufacturers, advertising agencies and public relations firms, Film Counselors, consultants on films for industry, has opened offices at 366 Madison Avenue, New York 17, N.Y.

The new organization does not undertake the actual production of films. Instead, it offers three major services: surveys to study the possible application of films to an advertising or training problem; supervision of film production; and film distribution and utilization planning.

Film Counselors is headed by two veterans who were associated before the war, with *The March of Time*.

COMING EVENTS

American Welding Society — 1946 annual meeting (reassembly) to be held in Atlantic City, November 17 to 22; headquarters at Municipal Auditorium.

National Metal Congress and Exposition—To be held in Atlantic City, November 17 to 22, headquarters at Municipal Auditorium.

Power Show—17th National Exposition of Power and Mechanical Engineering; to be held in New York City, at the Grand Central Palace, December 2 to 7.

ASME—American Society of Mechanical Engineers; mid-winter meeting, to be held December 2 to 7.

Stress Analysis—Annual meeting of the Society for Experimental Stress Analysis to be held in New York City, December 9, 10 and 11; headquarters at the Hotel New Yorker.

Heating and Ventilating Exposition—7th International Heating and Ventilating Exposition; to be held January 27 to 31 in Cleveland at Lakeside Hall.

Electrical Engineering Exposition—Annual show (Postponed since 1941) to be held in New York City, January 27 to 31; headquarters at 71st Regiment Armory, Park Ave. and 34th St.

AIEE—American Institute of Electrical Engineers; winter convention to be held January 27 to 31.

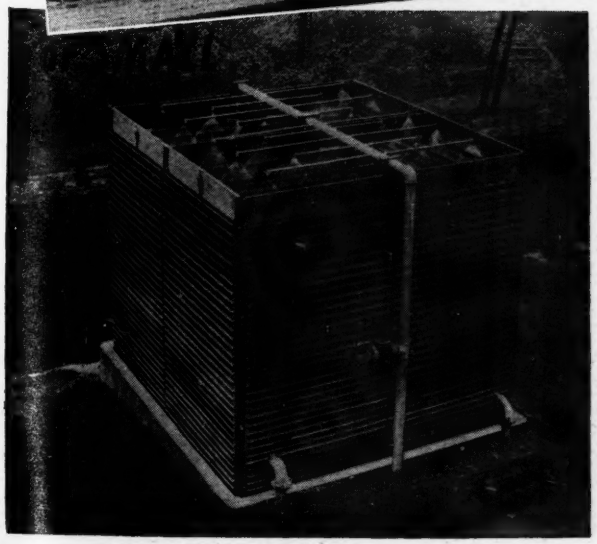
ASTM—1947 Spring Meeting and Committee Week of the American Society for Testing Materials; to be held in Philadelphia, February 24 through 28, with headquarters at the Benjamin Franklin Hotel.

ASTM—1947 Annual Meeting; to be held in Atlantic City, June 16 through 20, with headquarters at Chalfonte-Haddon Hall.

Instrument Society—Instrument Society of America annual meeting; to be held the week of September 8, 1947, with headquarters at the Stevens Hotel, Chicago.

Instrumentation Conference — Instrumentation Conference and Exhibit for 1947; to be held the week of September 8, with headquarters at the Stevens Hotel, Chicago.

For all their water cooling requirements...



...the "majority choice" of the nation's Industry

MARLEY "SpraCoil" Cooling Towers

For indirect (closed-system) cooling of gases, oils, soft jacket water—or for combining several such services in one cooling tower—Marley units of the types pictured here are providing pumping stations, gas compressor stations and recycling plants all over the country with the *dependable, flexible, efficient* and *economical* operation that meets the exact needs of each. Let us show you the installation list, the operating records, the details, features and construction of these towers.

THE MARLEY COMPANY, INC.
KANSAS CITY 15, KANSAS
Offices All Principal Cities
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MARLEY

TOP Marley SpraCoil tower of the Double-Flow Horizontal Induced Draft Type. **CENTER:** Marley SpraCoil tower of the Conventional Vertical Induced Draft Type. **BOTTOM:** Marley SpraCoil tower of the Natural Draft type.

Marley SpraCoil Bulletins available on request

POWER SHOW Booth 72

FOR EFFICIENT *Dust recovery*

SPECIFY BUELL'S exclusive . . . 6

"*Buell's Exclusive 6*" refers to the six design features which distinguish Buell (van Tongeren) Dust Recovery Systems from all other mechanical dust collectors.

These six mechanically-important features have made possible a three-point record of achievement in industrial dust recovery: (1) high operating efficiency (2) minimum cost of maintenance (3) long life. A record of *guarantees fulfilled*, of *virtually trouble-free service.*

"*Buell's Exclusive 6*" are briefly described in the paragraphs immediately below. In following sequential advertisements each feature will be separately illustrated and described in interesting detail.

1 The "Shave-Off" . . . The patented van Tongeren principle, exclusive with Buell. Utilizes the "double eddy" current, establishing a highly efficient collection force.

2 Large Diameters . . . Permit use of extra thick metal. Afford large dust outlets, prevent clogging. Reduce abrasion.

3 Extra-Sturdy Construction . . . Rolled and welded, one piece construction; hoppers braced with 3" channels to withstand vibration.

4 Correct Hopper Design . . . Plays a most important, often disregarded, part in dust collection efficiency. Dust disposal facility must be anticipated in the initial overall design.

5 Split-Duct Manifolding . . . A prime factor in efficient distribution of the dust load. Buell's manifolding method has flexibility, discharging gases from any side or end.

6 Inner Welds Ground Smooth . . . Proper finishing of inner welds effects operating efficiency, reduces erosion, ensures longer life.

Buell's book—"The van Tongeren System of Industrial Dust Recovery"—illustrates and explains the patented van Tongeren principle and its many applications to industry.

buell DUST RECOVERY SYSTEMS

BUELL ENGINEERING COMPANY, INC.

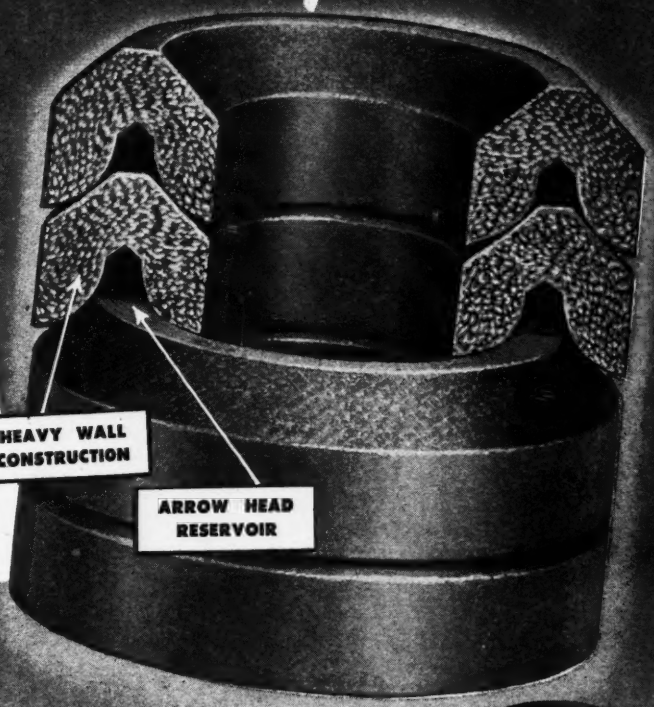
70 Pine St., Suite 4900, New York 5, N. Y.

Sales Representatives in Principal Cities

DESIGNED TO DO A JOB, NOT JUST TO MEET A "SPEC"

PALMETTO *Pyramid*

the most talked about "VEE" type molded packing



. . . talked about because

IT HAS EVERYTHING!

Packing users all over the country are talking about the new packing that *seals completely* with simple finger-tightening . . . that is *entirely automatic* in performance . . . that *stands up* longer under grueling service!

Here are some of the many features that make PALMETTO PYRAMID worth talking about—*and installing!* Its sealing action is effected by internal pressure . . . the greater the internal pressure —the tighter the seal. A unique "arrowhead reservoir", which stores and distributes the lubricant . . . plus the unusually heavy wall construction . . . reduces wear and adds to service life.

PALMETTO PYRAMID gives exceptional performance on reciprocating as well as rotating equipment . . . is recommended *without reservation* for a wide variety of services and conditions.

If you are operating hydraulic or pneumatic equipment—under tough conditions—it will pay you to investigate the PALMETTO line of Molded Packings. There's plenty of talk about their performance — because longer, more efficient, more economical service *always* gets talked about! Write now for full information on these PALMETTO Molded Packings: PALMETTO *PYRAMID*, PALMETTO *"U-RING"*, PALMETTO *KUP* and PALMETTO *FLANGE*.

PALMETTO "U-RING"

PALMETTO KUP

PALMETTO FLANGE

"It pays to know your PALMETTO Distributor!"

This coupon is for your convenience. Mail it today!

GT-1567

GREENE, TWEED & CO.
New York 66, N. Y.

☐ Send literature on PALMETTO Pyramid and other Molded Packings.

☐ Send PALMETTO representative to discuss packings.

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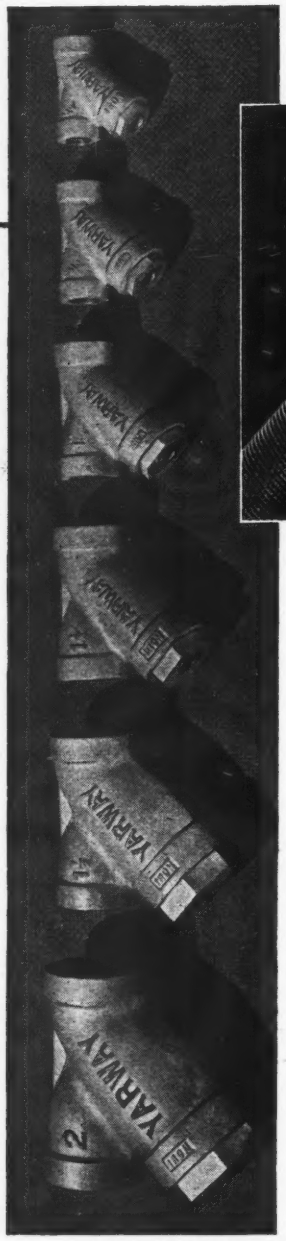
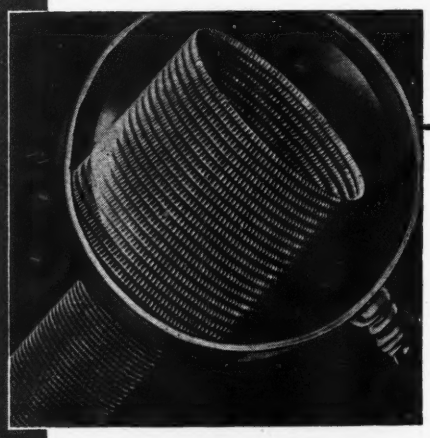
GREENE, TWEED & CO.
Manufacturers of PALMETTO Packings
... BLVD. AT 126th ST. NEW YORK 66, N. Y.
... at New York, N. Y. and North Wales, Pa.

PREVENT

Rust · Scale · Dirt

FROM CLOGGING
STEAM EQUIPMENT





YARWAY

STRAINERS

"The Screen's the Thing"

- *A High Grade Monel Woven Wire Basket* with mesh fine enough to catch the dirt—yet ample free area for passage of clean condensate, oil and other fluids.
- *Body Cadmium Plated for Protection Against Corrosion and for Better Appearance.*
- *Readily Removed Steel Blow-Off Bushing.*
- *Bushing Automatically Aligns Screen.*
- *Thousands in Use—Sold by Over 100 Mill Supply Houses.*
- *6 Sizes ½" to 2" for Pressures up to 600 Lbs.*

See Your Supply House or write for Bulletin S-201

YARNALL-WARING COMPANY

114 MERMAID AVENUE PHILADELPHIA 18, PA.

YARWAY STRAINERS

A-C ENGINEER HEADS AUTOMOTIVE SOCIETY

C. E. FRUDDEN, Consulting Engineer of the Allis-Chalmers Mfg. Co. Tractor Division, became the sole nominee for the 1947 national presidency of the Society of Automotive Engineers. The nomination is tantamount to election.

Mr. Frudden will be the first Wisconsin man and the first tractor man elected to the presidency of the 40 year old society. He will take office at the end of January and begin administering the affairs of the S.A.E. which is spread out over the United States, Canada and Hawaii.

KAHLER CHAIRMAN WASHINGTON AWARD

WILLIAM V. KAHLER, vice-president Illinois Bell Telephone Co., and first vice president, Western Society of Engineers, has been elected chairman of the Washington Award Commission for the year 1946-1947.

He has served on the commission as one of the representatives of the Western Society of Engineers since 1944.

The commission is charged with the duty of selecting the engineer whose professional attainments have pre-eminently advanced the welfare of mankind.

This award is for benefits of humanity, and there are no limitations as to education, membership in any society or organization, or circumstances of employment or official position.

The presentation of this award is made by the Western Society of Engineers at a joint meeting of the members of five participating societies, ASME, AIMME, ASCE, AIEE and Western Society of Engineers.

The first presentation of the award was made in 1919 to an engineer, Hon. Herbert C. Hoover and the last recipient in 1946 was Dr. Vannevar Bush.

TO BUILD NEW PLANT FOR WEST PENN POWER

AS PART OF a long-range program to meet the increasing demands for electric service in Western Pennsylvania, West Penn Power Co. has announced its plan to build a steam-operated power station on the southwest bank of the Monongahela River, between New Eagle and Elizabeth, near Courtney, Pa., about 20 miles from Pittsburgh.

The new plant, to be known as the Mitchell Station, will be named in honor of the company's President, H. L. Mitchell, who has been associated with West Penn for almost 45 years.

Mitchell Station will be close to West Penn's center of distribution, the Charleroi Substation, and will tie in through interconnecting lines with the company's electric system. The site of the new station was chosen not only because of the increased requirements for power in the Monongahela Valley area, but also to strengthen power supply for the entire territory served by West Penn.

Construction work will begin in February or March next year, and the initial installation will be one generating unit with a capacity of 80,000 kw. The first turbine to be placed at the new Station will be a duplicate of the recently-installed No. 7 turbine at Springdale. Provisions will be made to increase the capacity of the new Station to four units as the demand for power grows. Coal handling equipment and other general station facilities for both present and future installations will be part of the initial construction to provide for ultimate power station capacity.

The cost of Mitchell Station will be approximately 14 million dollars, and about 18 months will be required to construct the new plant.

H. J. Wollner, Secretary-in-Charge of the New York Office of the United Nations Standards Coordinating Committee, has announced that he has submitted his resignation. This resignation was forwarded to James G. Morrow, Chairman of the Executive Committee, which is the governing body. In undertaking the job of orgainzing western hemispheric activities of the Committee in 1944, Mr. Wollner had an understanding with the Committee that he would stay with the organ-

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CONDITIONING *of* WATER
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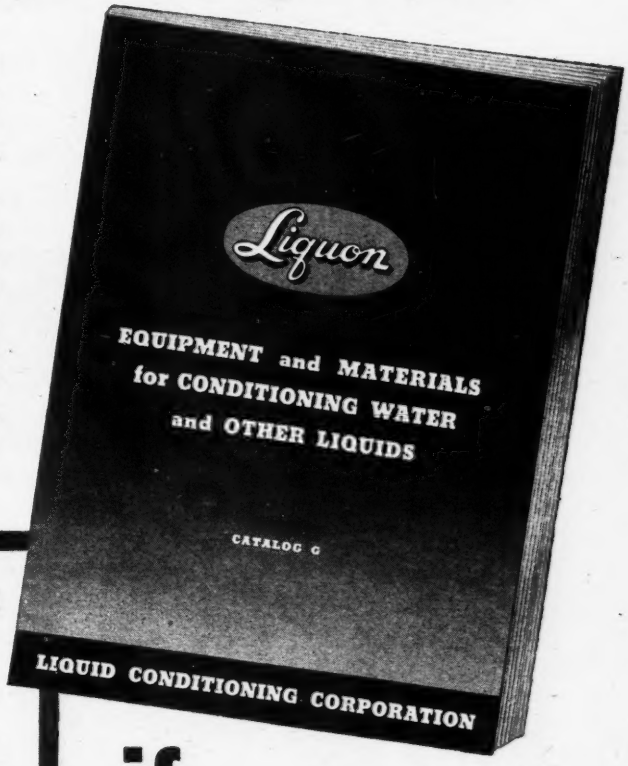
This helpful guide book on conditioning of water and other liquids has been prepared by leading authorities with more than a quarter century of specialized experience in this field.

It clearly explains and compares the many different processes and describes the most modern and effective methods and equipment for softening and clarifying water, and also for removing undesired impurities or recovering valuable constituents from other liquids. It will help you to determine the most practical conditioning method for your particular requirements, and to check the possibilities for modernizing and improving your present process.



Some of the Subjects Covered

WHY are different methods of water treatment in use?

HOW do these different methods of water treatment compare in the results obtained?

WHERE should each of the different methods of water treatment be used?

WHAT are the most advanced methods and equipment for water treatment?

WHICH is the most effective water treatment for removing hardness . . . alkalinity . . . minerals . . . turbidity . . . gases . . . other impurities?

WHEN can an existing water treatment installation be made more efficient with the same equipment?

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ization until June 30, 1946, by which time it was hoped a new international standards body, permanent in character and competently established, would have been created.

Obituaries

MURRAY KICE, JR.

MURRAY KICE, JR., Chief Engineer of American Blower Corp., Detroit, Mich., died on September 25th at Harper Hospital after a two-year illness.

Prominent in the heating and ventilating industry as a writer of many published articles, he was active in the American Welding Society, Engineering Society of Detroit, and ASME.

Mr. Kice was born in Louisville, Kentucky, in 1893. He received his public schooling there, his college training at Purdue University from which he graduated in 1915 with a B.S.M.E. degree.

Immediately following graduation, Mr. Kice began his life-long association with American Blower. Beginning as a mechanic in the fan shop, Mr. Kice soon became a sales engineer, successively in charge of the Columbus, Cincinnati, and Indianapolis territories. Since 1937, he held the office of Chief Engineer of the American Blower Corp.

SYLVESTER B. WAY

SYLVESTER BEDELL WAY, Chairman of the Board of Wisconsin Electric Power Co., was killed in an automobile accident near Suamico, Wis., in September.

Born in 1874 in Philadelphia, Mr. Way moved to Kansas with his parents and later returned to Philadelphia to attend Drexel

Institute of Technology. Following his graduation he worked for a short time for a manufacturer of storage batteries and was then offered a job with the predecessor of the present Union Electric Co. of St. Louis. In 1911 Mr. Way was sent to Milwaukee as Assistant General Manager to modernize the

Milestones in Service

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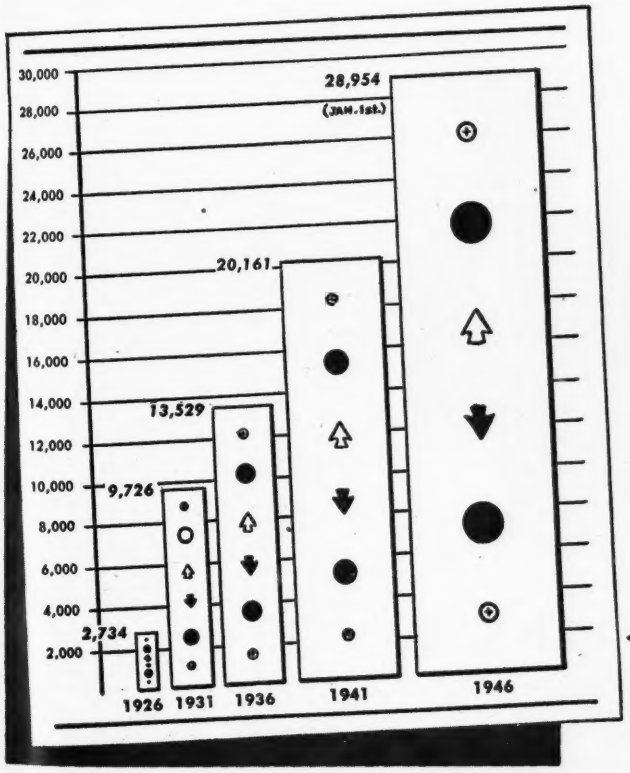
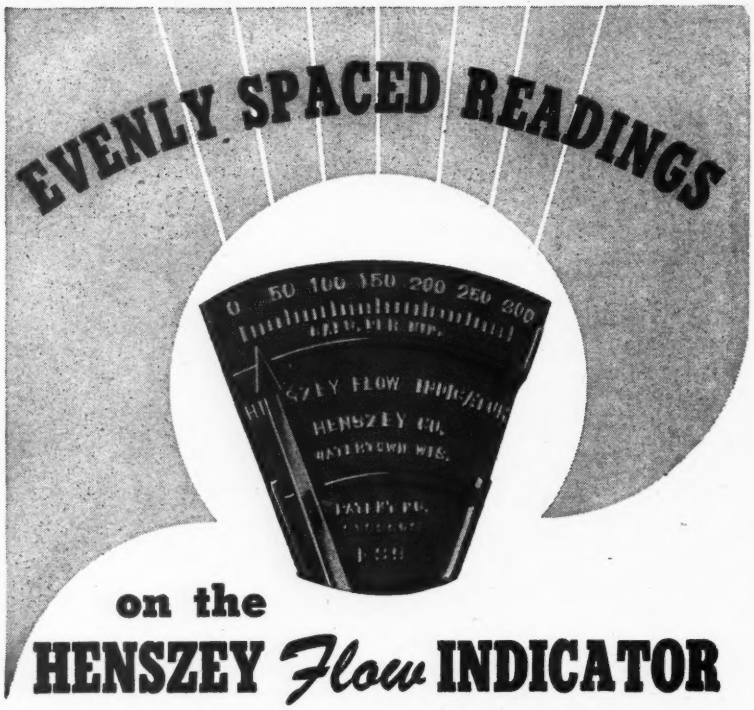
There are 245 Otis offices* but only one Otis Maintenance Service. • This service is a home town enterprise in operation, so that it may be adapted to the area it serves. It is a national enterprise in research, engineering and manufacturing so that each Otis elevator owner may have the best that concentration and quantity production can provide. • Perhaps the strongest indication of the merit of this service is its growth and development. For more than a quarter of a century, in good times and bad, Otis Maintenance has proved the wisdom of one policy, one system and national service for Otis Elevator owners. • Otis Maintenance provides complete care of Otis elevator equipment by the manufacturer. It is furnished at a flat monthly rate. Complete details are available through local Otis Elevator Company offices.



←**Number of Elevators under Otis Maintenance. The steady increase in the number of elevators maintained for owners by Otis offers convincing proof of the economy and efficiency of *maintenance by the manufacturer.***

******Otis offices in 245 cities have but one interest . . . to provide the best and safest elevator and escalator transportation possible.*



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HENSZEY *Flow* INDICATOR

From zero to 100% the markings on the dial of this rugged instrument are spaced in equal units to insure accurate readings at all times. The rate of flow is instantly revealed — no constants are needed to translate readings into the desired information.

There are only three moving parts in the Henszey Flow Indicator — no breakdowns due to complicated gears and mechanisms. No additional supports are needed — it goes right in the line — indicating the pulsating flow of reciprocal pumps exactly as it occurs.

Consider Henszey Flow Indicators for your tough rate-of-flow problem. Installations are satisfactorily performing in nationally known manufacturing plants of all kinds. Send for bulletin FI-1.

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power generating and distribution systems there. In 1912 he became vice president, in 1914 General Manager and he was elevated to the presidency in 1925.

Mr. Way took the responsibility for designing the Lakeside power plant to burn pulverized coal, a practice which, at that time, was considered highly revolutionary.

Mr. Way is survived by his wife, a daughter, Mrs. Charles, H. Klinger of Santa Barbara, Calif., and a half brother, A. A. Alexander of Everest, Kas.

J. L. McMILLAN

JOHN LOUDON MCMILLAN, 87, inventor, died recently at his home in Syracuse, N.Y. Mr. McMillan is credited with the discovery that one electric generator could be used to drive a second generator as an electric motor. Mr. McMillan had twenty-three patents issued to him and in 1901 he organized a company to build a turbine engine of his own design. This company closed its doors, however, in 1904. Mr. McMillan later reorganized the Remington Arms Co. and became its first president.

F. A. PATTISON

FRANK A. PATTISON, 80, partner in the now dissolved consulting and mechanical engineering firm of Pattison Bros., New York, which designed the electrical, mechanical, heating and ventilating systems of many important buildings in New York City, died recently at his home in Colonia, N.J.

Outside of New York some of the more famous jobs engineered by Mr. Pattison and his brother included the Montreal Stock Exchange Building, the Public Service Corp. and Prudential Life Insurance Co. of America buildings, both in Newark, N.J. and buildings in Cleveland, Boston and Providence.

Mr. Pattison was a member of the ASME, the AIEE and the Engineers Club of New York..

He is survived by his wife, Mrs. Mary Stranahan Hart Pattison; a son, M. Munn Pattison, and a daughter, Mrs. Diantha P. Wydenbrook.

GROVER F. ILGEN

GROVER F. ILGEN, 58, vice president and general sales manager of Airetool Manufacturing Co., Springfield, Ohio, died Aug. 27, in University hospital, Columbus, Ohio.

Mr. Ilgen had been associated with the company since its inception in 1930 by his friend and business associate, W. T. Hamilton, Airetool's president.

Through his travels in North, South and Central America as Airetool's representative, Mr. Ilgen became one of the best known figures in the tube cleaning and tube rolling industry. For years he had served the major refineries of the United States and Mexico as a consultant on tube cleaning and tube rolling problems.

Mr. Ilgen's association with Mr. Hamilton began when the latter was connected with the Press-Republic, a newspaper in Springfield in the early 1900's. He followed Mr. Hamilton to the Lagonda Co., as a draughtsman. When the company was sold to the Elliott Co., in 1918, Mr. Ilgen started a business venture of his own. He rejoined Mr. Hamilton when the latter organized Airetool, serving as engineer and the company's first salesman.

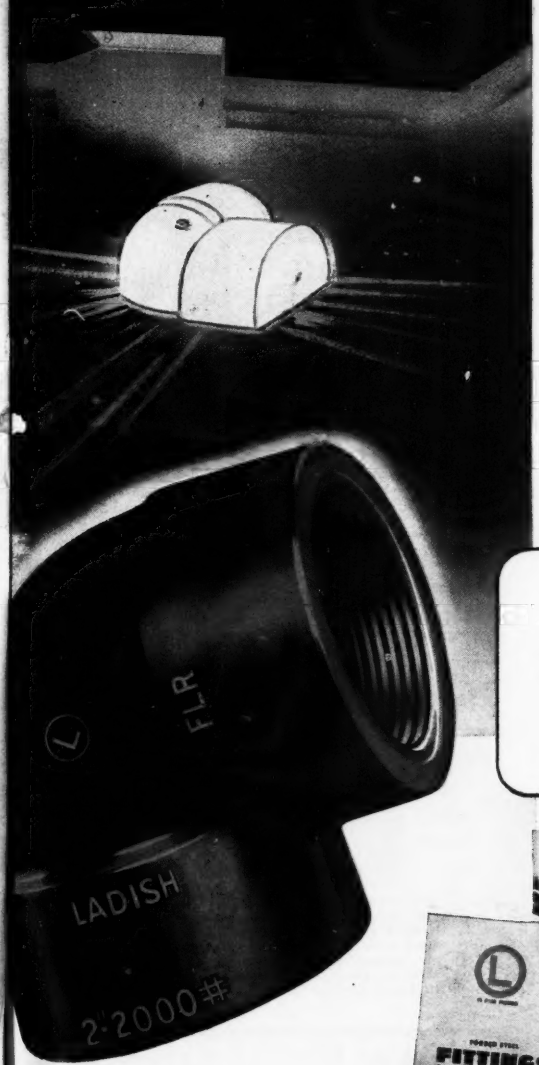
Mr. Ilgen was a native of Springfield, O. He is survived by his widow, Mrs. Hazel Ilgen, and one son, Grover William Ilgen, recently discharged from the Army Air Corps and now a student in Ohio State University.

B. V. E. NORDBERG

B. V. E. NORDBERG, son of the late Dr. Bruno V. Nordberg, founder of Nordberg Mfg. Co., died August 19, at the age of 62. Mr. Nordberg was born in Milwaukee, educated in the public schools and graduated from the University of Wisconsin in 1907. Following graduation he became an employe of the Nordberg Manufacturing Co. serving in various capacities, and since 1923 had been Executive Engineer.

Mr. Nordberg took an active interest in various engineering groups, and was a member of the following professional and engineering organizations: Society of Automotive Engineers, Society of Naval Architects and Marine Engineers, American So-

NEW FREEDOM *from* Concealed Defects



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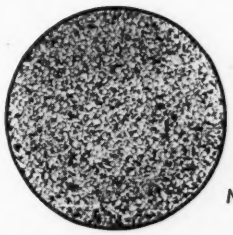
These tremendous impact pressures . . . applied when the top quality steel has been heated to correct plasticity . . . produce a denser, more homogeneous metal structure, eliminating the possibility of concealed defects and porosity which can often be the cause of premature leaks and failures.

This soundness that means dependable, trouble-free service is inherent in every Ladish Forged Steel Fitting . . . just one reason why it's *sound* economy always to specify Ladish Forged Steel Fittings for your piping requirements.

A micro section of any Ladish Forged Steel Fitting shows uniformity and refined metallic structure, completely free of defects.



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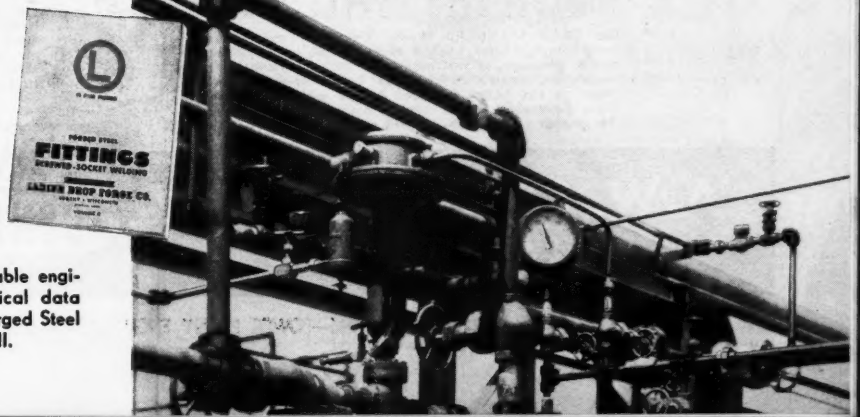

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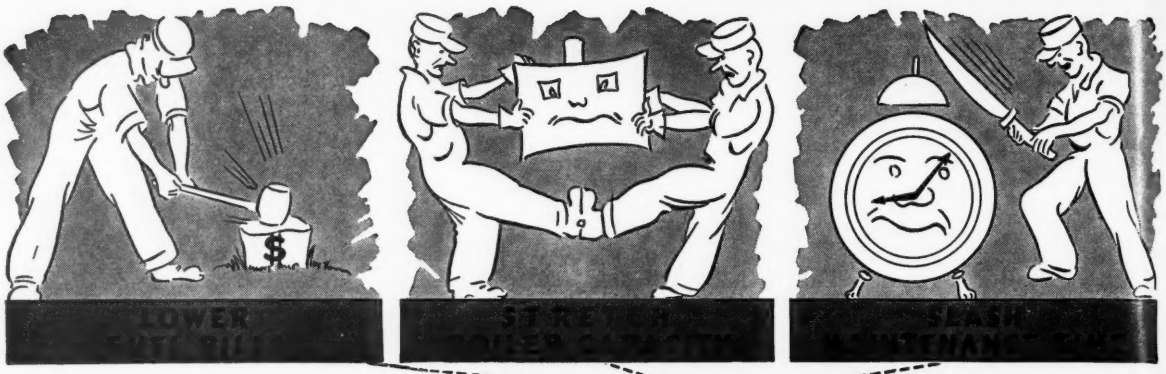
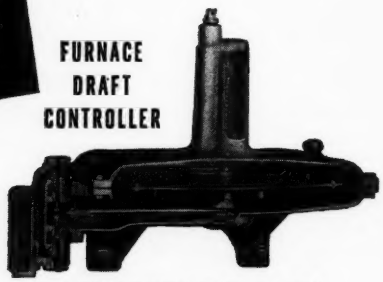


GET THESE THREE RESULTS IN YOUR BOILER ROOM WITH···

CASH STANDARD AUTOMATIC COMBUSTION CONTROL SYSTEMS

FURNACE DRAFT CONTROLLER



This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber.

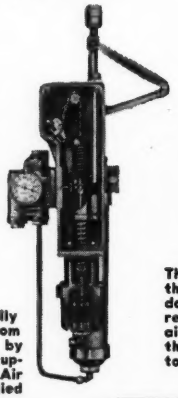
TO achieve maximum boiler output with the least amount of fuel and attention, you must have Correct Fuel Feed — Proper Air Supply — Constant Over-Fire Draft.

You accomplish this simply by installing a CASH STANDARD Automatic Combustion Control System. These units work as efficiently on multiple-boiler batteries as on single boilers.

CASH STANDARD Units can be combined to make a most accurate and dependable Automatic Combustion Control System to meet any condition and work on any boiler with any kind of fuel.

• Read about the application and operation of this system.

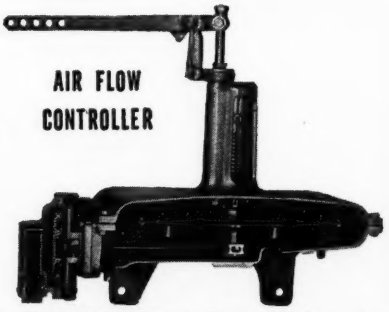
Write for a copy of our fully descriptive bulletin No. 300.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion—hence, money saving.

AIR FLOW CONTROLLER



This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.

A. W. CASH COMPANY
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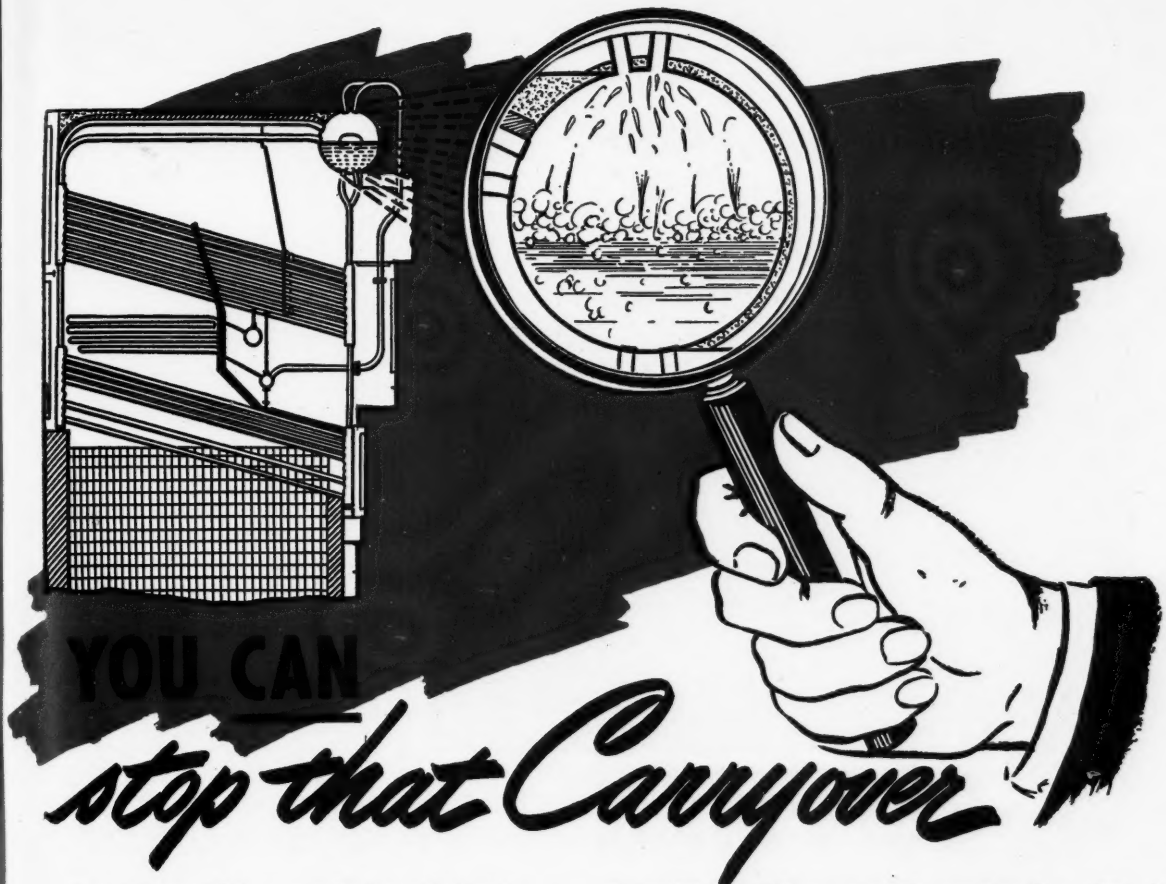
CASH STANDARD CONTROLS . . VALVES



YOU CAN *stop that Carryover*

Are you one of the many in the unfortunate position of having to "baby" their boilers to prevent entrainment of boiler water solids with the steam?

Such entrainment may lead to deposits in steam lines, superheaters, turbines and other process equipment. These solids may also interfere with process operations as in the case of breweries, laundries, etc.

Most cases of carryover are due to the combined effects of suspended and dissolved solids in the boiler water. If either is decreased, more of the other can be tolerated. Dissolved solids can be decreased by blowdown but this has little effect on suspended matter. If, however, the suspended matter is coagulated properly it will drop rapidly to the lower parts of the boiler where bottom-flash blowing will remove it with little loss of water.

Ameroid Coagulants, used in conjunction with proper chemical treatment, have proved to be excellent for this purpose. In addition to coagulating the suspended matter, they make the sludge non-adherent to metal, thereby eliminating baked-on deposits.

Contact **the Drew man and find out how AMEROID, The Complete Boiler-Water Treatment, can be used to "lick" your carryover problem.**

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COMPLETE AMEROID SERVICE **is available in key cities of the United States, Canada, Mexico, Brazil and Puerto Rico.**

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WITH HOFFMAN DUST REMOVAL EQUIPMENT

1 **COAL DUST DEPOSITS PRESENT EXPLOSION HAZARDS**
Hoffman vacuum cleaning equipment is the economical way to rid your plant of hazards. Coal dust deposits are quickly and economically removed.

2 **ASH DUST ACCUMULATIONS ARE HEALTH HAZARDS**
A Hoffman stationery system – or heavy duty portable cleaner accomplishes a more thorough cleaning job with less work, improves your working conditions.

3 **ORDINARY HAND CLEANING IS EXPENSIVE, INEFFICIENT**
Vacuum cleaning removes dust without scattering it. Broom sweeping only aggravates dust conditions, stirs up clouds of fine dust to settle elsewhere.

4 **OVERHEAD DUST INCREASES CLEANING PROBLEMS**
Hoffman vacuum equipment enables you to keep down overhead dust accumulations. Eliminates much damage to plant equipment.

WRITE FOR HELPFUL LITERATURE

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ciety of Mechanical Engineers, American Water Works Association, American Interprofessional Institute, Society of Military Engineers and Engineering Society of Milwaukee. He also took a prominent part in civic affairs. At the time of his death he was Vice Chairman of the Milwaukee Sewerage Commission, having been a member of that Commission since 1926. He was also Vice Chairman of the Wisconsin Registration Board of Architects and Engineers, Regent of the Milwaukee School of Engineering and on the Advisory Board of Marquette University.

He is survived by his wife, son, daughter and two grand children.

MANUFACTURERS' *News*

LOCOMOTIVE GAS TURBINE

GAS TURBINES for locomotives, recognized as a "natural" application for this new form of prime mover, are well on their way to realization in this country. The Elliott Co., Jeannette, Pa., who built the first successful 2500-hp marine gas turbine power plant, announces it has just received a contract for a locomotive gas turbine from the Locomotive Development Committee of Bituminous Coal Research, Inc.

This gas turbine, to be rated 3750 hp at the turbine coupling will burn pulverized coal, incorporating the methods developed by Bituminous Coal Research. The turbine will be a simple cycle machine. A two-stage centrifugal compressor will discharge through a combustion chamber to a multi-stage reaction turbine. Maximum operating temperature will be 1275 F, which has been conservatively selected to make possible the use of high-temperature alloys of proven characteristics. This compact, light weight, and very simple machine will have an efficiency about three times that of existing coal-burning steam locomotives.

It will be so compact that a gas turbine locomotive can have double the power of present-day locomotives of equivalent length. In addition to developing high power in small space, the gas turbine locomotive has the big advantage of requiring no water. It is anticipated once the first machine is proven, that ultra-modern locomotives can be built to develop 6000 hp in a single cab with gas turbine power equipment.

This first locomotive will be driven through standard electrical transmission equipment and will be capable of producing 3000 hp at the rails in a single locomotive cab.

GRAVES NEW GIBSON ELECTRIC CHIEF ENGINEER

HERBERT C. GRAVES, JR., has been appointed Chief Engineer for Gibson Electric Co., Pittsburgh, Pa., according to a recent announcement.

Previous to joining Gibson Electric Co., Mr. Graves was engineering manager for I-T-E Circuit Breaker Co. and, during the war, was in charge of Navy activities for that company. In this latter capacity he served on several committees appointed by the Electrical Design Section of the Bureau of Ships, Washington, D. C. Prior to joining the I-T-E Circuit Breaker Co. he was employed first by the Union Gas and Electric Co. of Cincinnati and then by the Westinghouse Electric Corp. as a relay application engineer.

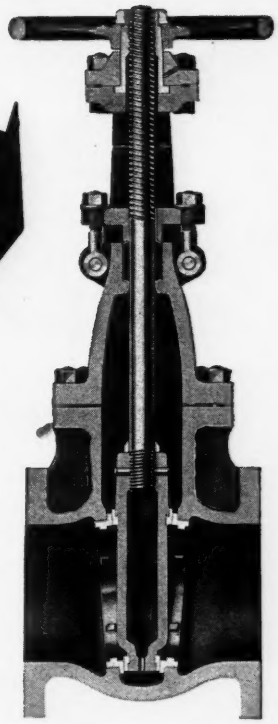
BAILEY ASSIGNS ENGINEERS

BECAUSE OF substantial increases in new construction and modernization of central station, industrial, and marine power plants, Bailey Meter Co., Cleveland, Ohio announces additions to its staff of 80 field engineers, located in 30 industrial areas throughout the United States and Canada. New assignments are: Thos. M. Nourse to its Buffalo branch office in the Ellicott Square Building. Peter M. Harris to its San Francisco branch with

Every feature you want in an

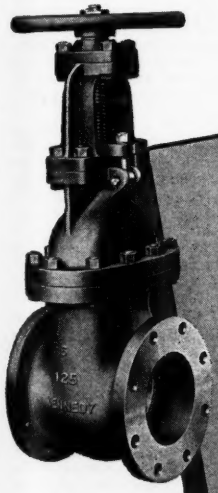
IRON BODY WEDGE GATE VALVE

is in this KENNEDY DESIGN



Whether you examine this Kennedy Standard Iron Body Wedge Gate Valve for basic features that assure ample strength, long service and trouble-free operation, or for refinements that provide extra conveniences and ease of assembly, operation and maintenance, you will find a design that gives you extra values . . . at no extra cost.

Engineers who have tried these valves have become so enthusiastic about their many superiorities that plants all over the country have standardized on them for iron-body wedge gate valve services. These superiorities are fully described in the 240-page Kennedy Catalog, which also shows the entire Kennedy line of bronze and iron body gate, globe, angle and check valves, malleable iron and bronze screwed pipe fittings, and cast iron flanged fittings and flanges. Be sure to write for your copy today . . . you will find it a valuable help in the selection of valves and pipe fittings for your requirements.



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YOU WANT THESE VALVE FEATURES
. . . you'll find them in this KENNEDY design

1. **Generous Strength . . .** Body and bonnet are of high-grade dense metal with ample thickness and rounded fillets. Stem has large diameter and extra large number of contact threads.
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3. **Lasting Tightness . . .** Discs and seats seat accurately, and their sturdy design resists distortion and has special provisions for take-up of wear.
4. **Long Life . . .** Many Kennedy valves have been in daily use a quarter century and more.
5. **Convenient Repacking . . .** Glands and packing are easily accessible.
6. **Economical Maintenance . . .** Long wear built into all parts, and adjustments or other attention are seldom required.

THE KENNEDY VALVE MFG. CO.
Elmira, New York

KV-137

KENNEDY *valves - pipe fittings - fire hydrants*

DARTS are Quickly Demountable

TWO BRONZE SEATS GROUND TO A TRUE BALL JOINT PERMIT EASY UNCOUPLING

Whenever you wish to move a Dart Union to a new location, you'll find no trouble in uncoupling it. Because of its two bronze seats which have been ground to form a true ball joint, it closes to a drop-tight connection without excessive wrenching. Thus, undamaged, it will open easily whenever needed elsewhere.

Body and nut are of high-test air-refined malleable iron —are practically unbreakable.

Ask your supplier to send Darts —the most economical unions in length of service.

E. M. DART MANUFACTURING CO.
PROVIDENCE, R. I.

DART UNIONS

headquarters in the Sharon Building. Arthur J. Schager to its New York branch, 30 Church St. Robert. F. Talbert to its Detroit branch office in the Curtis Building. George J. Dunegan to its Pittsburgh office located in the Oliver Building. Gilbert Peters to Denver.

These new men have completed an extensive training course at the company's factory in measurement, combustion, and automatic control especially as it applies to power plants.

The company reports that J. J. Haslam is returning to its Kansas City branch office after having been on active duty with the Marines. Also that H. W. Hilker has been transferred from Cleveland to its Los Angeles branch office at 1709 W. 8th St.

SIER-BATH CHANGES NAME

SIER-BATH GEAR AND PUMP CO., Inc., is the new name of the former Sier-Bath Gear Co., Inc. located at 9252 Hudson Boulevard, North Bergen, N.J. According to E. J. Bianchi, President, this change in corporate name was made in order to make it truly representative of the company's expanded line of products. In addition to the precision gears, which Sier-Bath has manufactured since 1905, they also make screw pumps and Gearex rotary pumps.

PEEBLES OF HAGAN CORP. RETIRES

EIGHTY-ODD fellow workers and friends paid tribute at a dinner in the Duquesne Club recently to T. A. ("Tom") Peebles, vice-president in charge of engineering of Hagan Corp. as he announced his retirement and ended 30 active years with the company he helped to found.

The surprise dinner to the man who did so much to equip industry's steam boilers here and abroad with automatic combustion control was organized by J. M. Hopwood, president of the company, who acted as master of ceremonies. Most of the guests were Hagan associates, some from earliest days, but a few were close personal friends outside the company.

AWS ANNOUNCES PROGRAM

THE TWENTY-SEVENTH annual meeting of the American Welding Society will be held at the Hotel Ambassador, Atlantic City, N.J., on November 17-22, inclusive. A total of 80 technical papers has been scheduled for presentation at the 24 sessions covering 15 divisions of the welding field.

The papers include 11 papers on welding research, 13 on resistance welding, four on pressure welding, seven on cutting, three on weldability, three on railroad applications, three on electrodes, four on production welding, three on pressure vessels and storage tanks, three on machinery, three on shipbuilding, four on aircraft, three on structural welding, four on hard surfacing and three on high alloys. In addition, nine papers will be presented covering a variety of subjects such as the arc welding of cast iron with nickel electrodes, flame-hardening and plant maintenance.

The President of the Society, Wendell F. Hess, will preside at the Annual Dinner on November 21 during which the presentation of medals and prizes will be made. Other features of the meeting will be the Adams Lectures on Monday evening, November 18, to be given by Dr. Hess, Rensselaer Polytechnic Institute; the University Research Conference on Tuesday evening, November 19, and the annual dinner of the Section Officers, followed by session devoted to Section Activities, on Wednesday evening, November 20.

Houdry Process Corp., Wilmington, Del., announces the removal of its New York Offices to 25 Broad St., New York 4, N. Y.

Kieley & Mueller, Inc. has announced the appointment of the Fluid Controls Co., 18 West Chelton Bldg., Philadelphia 44, Pa., as its accredited representatives in the Philadelphia-Harrisburg area. This company will handle the complete line of Kontrol-Motor Diaphragm Valves, Pressure Regulators, Pump Governors, Float Valves.

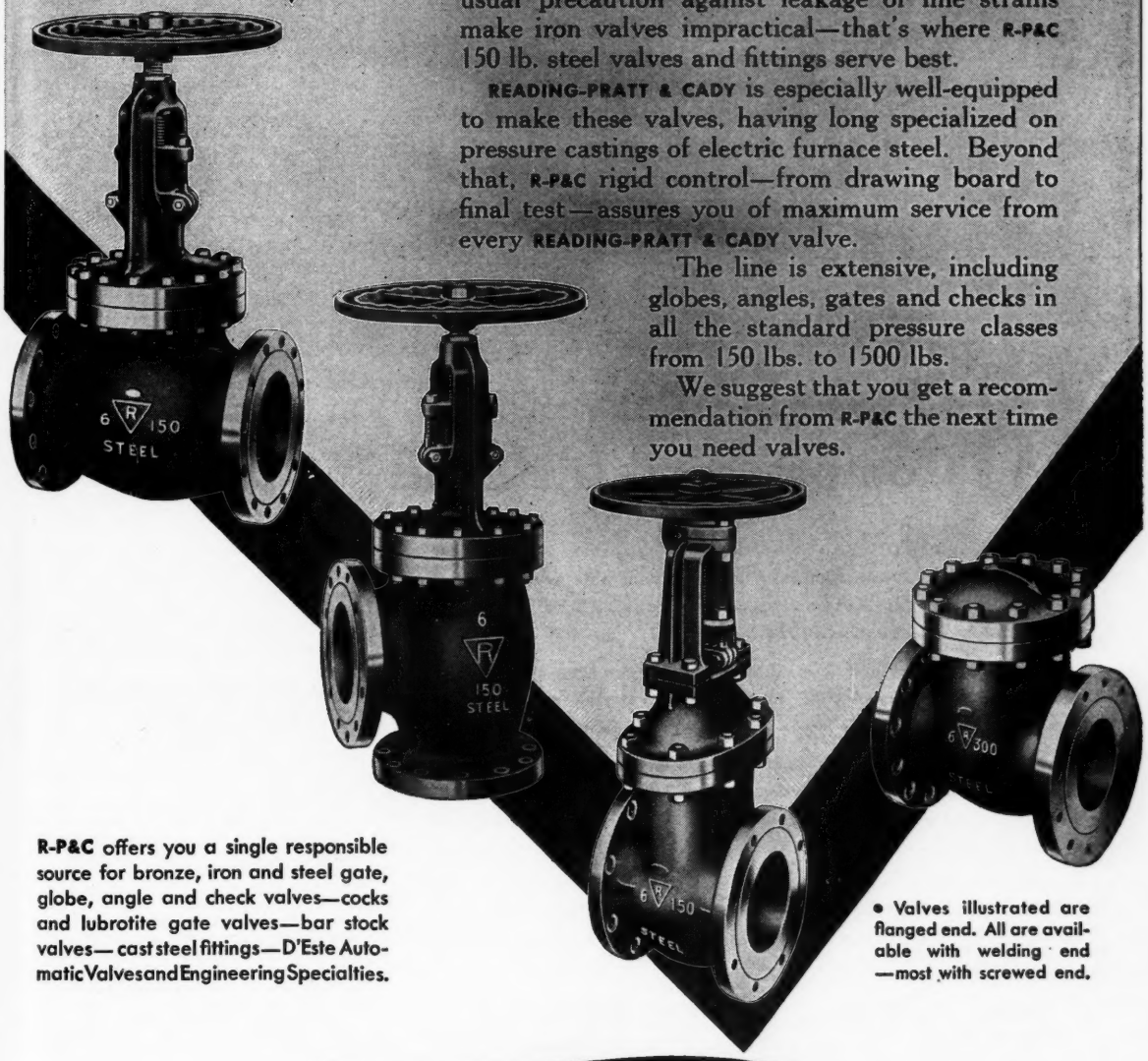
Where conditions of service call for STEEL

. . . in the low pressure range where high temperature, corrosive liquids, fire hazards or need for unusual precaution against leakage or line strains make iron valves impractical—that's where **R-P&C** 150 lb. steel valves and fittings serve best.

READING-PRATT & CADY is especially well-equipped to make these valves, having long specialized on pressure castings of electric furnace steel. Beyond that, **R-P&C** rigid control—from drawing board to final test—assures you of maximum service from every **READING-PRATT & CADY** valve.

The line is extensive, including globes, angles, gates and checks in all the standard pressure classes from 150 lbs. to 1500 lbs.

We suggest that you get a recommendation from **R-P&C** the next time you need valves.



R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Valves and Engineering Specialties.

• Valves illustrated are flanged end. All are available with welding end—most with screwed end.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE VALVE AND ENGINEERING SPECIALTIES

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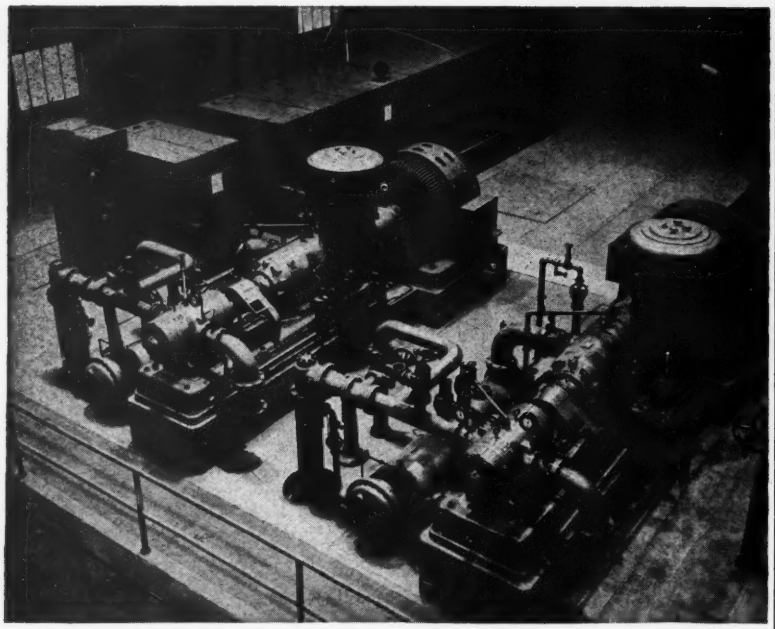
READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

ACCO TRADE MARK

In Business for Your Safety



28 Fuller Rotary Compressors Installed

Starting in June 1940, one of the larger steel companies purchased its first Fuller Rotary Compressor, and has continued this policy until at the close of 1944 they had purchased and installed 28 Fullers. Truly a very fine recommendation for these machines.

Installation illustrated above shows two of the two-stage compressors, each having a capacity of 1800 c.f.m. actual free-air delivery, at 125-lb. pressure. These machines furnish air for general plant use.

The capacity of machines installed range from a small 5-lb. to 50-lb. gas booster to the larger two-stage of 1800 c.f.m., 125-lb. pressure for general plant use. Most of them, however, are the larger two-stage type.

Fuller Rotaries will give you years of efficient service . . . we invite your inquiries and investigation. Write for Bulletin C-5, fully describing and illustrating these machines.

FULLER ROTARY COMPRESSORS AND VACUUM PUMPS — BUILT FOR CAPACITIES TO 1800 C.F.M. PRESSURES TO 125 LB. VACUUMS TO 29.90 IN. REFERRED TO 30-IN. BAROMETER

FULLER COMPANY
CATASAUQUA, PENNSYLVANIA

Chicago 3 - 1144 Marquette Bldg.
San Francisco 4 - 421 Chancery Bldg.
Washington 5, D. C. - 618 Colorado Bldg.

C-124

FULLER
PIONEERS OF HIGH-EFFICIENCY ROTARY COMPRESSORS

G.E.'s HANFORD OPERATION

UNDER ITS agreement with the government for research and development in the atomic energy field, the General Electric Co. announced recently that its Chemical Department will be responsible for the operation of the $347,000,000 Government-owned Hanford Engineer Works at Richland, Wash., when operation of the Works is transferred to G.E. by the E. I. duPont deNemours and Co. on September 1.

NEW VALVE PIPING COMPANY

TO MEET the demand for specialized knowledge of unusual piping problems developing in the chemical, heating, and allied production fields, Ray Miller, specialist in corrosion resistant materials, has formed his own company to market a complete line of pipe, valves, fittings and tubing in stainless steel, aluminum, plastics, and other resistant materials. The new company to be known as Ray Miller, Inc. will also distribute sanitary stainless steel fittings, valves, pumps and tubing. Executive offices will be located at 54 Clinton Street in Newark, N.J.

SNAP-ON TOOLS' NEW PLANT

ESTABLISHMENT OF a Canadian factory, the fourth production plant for Snap-on Tools Corp., Kenosha, Wis., has been announced.

Operations at the new plant located at Long Beach, Ontario, have already begun. This factory, operated by Snap-on Tools of Canada, Ltd., will supply the majority of the Canadian tool needs and allow Snap-on's three American factories to concentrate on domestic tool demands.

G.E.'s WATERFORD PLANT

REDUCED COSTS and a consequent broadening of uses for silicone products will be affected gradually by the General Electric Co. when production is started in Waterford, N.Y. sometime after Jan. 1 in a new G-E factory now under construction. The new plant is said to be indicative of General Electric's faith in the silicone business and predicted that expected expansion would eventually make Waterford a leading manufacturing cetner of a rising young industry.

NEW ENGINEERING SERVICE FOR PIPING LAYOUTS

PIPING LAYOUT design is a new service inaugurated by the Engineering Department of Pennsylvania Flexible Metallic Tubing Co., Philadelphia.

This innovation was first tried out in answer to an apparent need. It met with such a welcome—especially from manufacturers and constructors whose engineering staffs were short-handed or who felt the need for specialized experience—that it was decided to make it a new departmental service.

It includes, besides problems in piping layout, those involving absorption of line vibration, flexible connections, special fittings, the handling of pressure pulsations, changes in temperatures, water and air jacketing.

Liquid Conditioning Corp., New York City, has announced the appointment of the following engineering sales representatives : John B. Foley, Syracuse, N.Y.; Arthur W. Schuster, Rochester, N.Y.; Brookman-Hazel Associates, Buffalo, N. Y.; The Herr-Harris Co., Pittsburgh, Pa.; P. O. Stribling, Jr., Greensboro, N.C.; and The Dorner Co., Milwaukee, Wisc.

PENNFLEX OPENS SYRACUSE OFFICE

AS PART of its new program of increased customer service, the Penflex Sales Co. Division of Pennsylvania Flexible Metallic Tubing Co. has opened an office in Syracuse.

It will be in charge of William V. Pyndus and is located at 416 Loew Theatre Building, 108 West Jefferson Street.

The territory served by him was formerly

"No trouble with Rust ...since switching to Tycol RIO Turbine Oils"

"No detectable sludge...
No emulsification...
Viscosity unaltered...
Negligible change in acidity"

That's how engineers describe the improved results achieved with Tycol RIO Turbine Oils. These oils assure maximum economy . . . unqualified protection . . . top lubrication efficiency.

Contact your nearest Tide Water Associated Office today for complete data on the many advantages of Tycol RIO Turbine Oils.

LUBRICATION—"ENGINEERED TO FIT THE JOB"

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C.
Pittsburgh • Philadelphia

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N. Y.

Belmont's Semi-Metallic Packing —asbestos channel with special metal center—PATENTED.

Closest to Friction*less Seal

Soft metal volutions which bulge toward the rod under gland pressure make Belmont's No. 865 Semi-Metallic Packing the ideal seal for high-pressure steam rods, valve stems and air compressor rods. It's a tight, metal-to-metal, practically friction-less seal.

The unique, spirally-wound metal is encased in a stitched asbestos channel. The packing is so flexible that it can be formed around small diameters.

Have your Belmont distributor furnish you with Belmont's 865 (ring form) or 866 (spiral form). For low pressure steam, hot and cold water rods and plungers and ammonia rods, specify Belmont 860 (ring) or 861 (spiral)—same as 865, with stitched rubber-and-duck channel on three sides.

THE BELMONT PACKING & RUBBER CO. —BELMONT— PHILADELPHIA, U.S.A.

IN THE BLUE-AND-ORANGE BOX

THERE IS A BELMONT PACKING FOR EVERY SERVICE . . . Belmont distributors are located in every large industrial center, ready to give you prompt delivery from local stocks.

6 New Folders

Write us for new folders on Belmont Centrifugal and Rotary Pump Packings, Flax Packings, Hollow Center Packings, Oil and Gasoline Packings, Rod Packings, Sheet Packings.

THE BELMONT PACKING AND RUBBER CO.

Butler and Sepviva Streets

Philadelphia 37, Pa.

covered by four other branch offices. In addition to Syracuse, it will include such important cities as Binghampton, Buffalo, Elmira, Jamestown, Niagara Falls, Rochester, Rome, Schenectady, Utica as well as many smaller but equally active manufacturing centers.

K & M's NEW REPRESENTATIVE

KIELEY & MUELLER, INC., North Bergen, N. J., announces the appointment of Fluid Controls Co., of Philadelphia, Pa. as representative in the Philadelphia area.

This organization will act as Sales Agents for the new line of Kontrol Motor diaphragm valves, pressure regulators and pump governors.

The Fluid Controls Co. is equipped to render highly technical engineering service on any control problems which might arise.

PENNSON CORP PURCHASES McINTYRE

THE PENNSON CORP., New York City and Waltham, Mass., has announced the purchase of The McIntyre Co., Newton, Mass. This is the Pennson Corp's. second acquisition and is to be combined with its first purchase; the Waltham Horological Manufacturing Co., Waltham, manufacturers of precision parts.

The McIntyre Co. is a manufacturer of high precision industrial hydraulic and water pumps and fluid motors.

George P. Robinson, president of the Pennson Corp., has announced that Eben S. Upton, vice president and Douglas Sloane, treasurer of the parent corporation will join R. Louis Towne, general sales manager and Charles Kester, production manager of The McIntyre Co. as an executive committee, which will administer policies of the two combined companies.

PERMUTIT STUDIES S. A. WATER SUPPLIES

THOMAS P. BROWNE, Manager of the Export Department of The Permutit Co., left recently for South America to study water supply problems and to deliver a paper on recent developments in water conditioning before the forthcoming Pan-American Sanitary Conference.

Included on Mr. Browne's itinerary are stops at Puerto Rico, Venezuela and Colombia where he will confer with representatives of the municipal and industrial water supply fields on South America's water conditioning needs.

Mr. Browne is well known in South America, having participated in the installation of water conditioning plants in Mexico, Colombia, Puerto Rico and Brazil. During the war, he was a Colonel in the Army Engineers Corps where he supervised and instructed personnel connected with supplying water to troops. He served both in this country and in the European theater.

B & W BUYS ALLIANCE WAR PLANT

THE BABCOCK & WILCOX TUBE CO. has purchased the welded boiler tubing plant at Alliance, Ohio, from the War Assets Administration for $1,315,794.50.

This plant was erected in 1942 at the request of the government and has been operated since that time by the company. It was built by Babcock & Wilcox for the Defense Plant Corp. of the Reconstruction Finance Corp. It is one of the country's largest and most modern specialty mills, and has become an important adjunct to the company.

Included in the purchase are: a two story office building; a combination gate house, personnel office and first aid station; the main manufacturing building of 104,000 sq ft; another manufacturing building of 28,600 sq ft; and a power house containing two 284 hp B & W Integral-Furnace Boilers. Equipment in these buildings is included in the sale price.

Construction of the plant was started in July, 1942, and it was in production January 1, 1943. It was built to produce 4,000 tons of ¾ in. to 4 in. welded tubing each month. The plant is located on Keystone Street, adjacent to the B & W plant on Rush Street.

There's Only One Key

to the solution of your boiler water trouble

● Boiler water troubles, like locks, respond to one key . . . *and there is no master key* of one treatment for all waters.

The Dearborn Engineer has found, through the years, that proper boiler water analyses, linked with a specific chemical treatment, can unlock the most stubborn boiler water problem.

In the boiler room, he first takes steps to curb the immediate water trouble. Then he studies operating conditions and sends water samples to the laboratory.

● All of his findings are checked at Dearborn laboratories. Here the skill of experts in water analysis, interpretation and research is trained on your individual problem. The key to its solution is produced and transmitted to the Dearborn Engineer who calls on you . . . a corrective water treatment formulation, together with proper dosage instructions and application method.

Through the years this scientific individual service has proved its dependability and reliability.

Dearborn

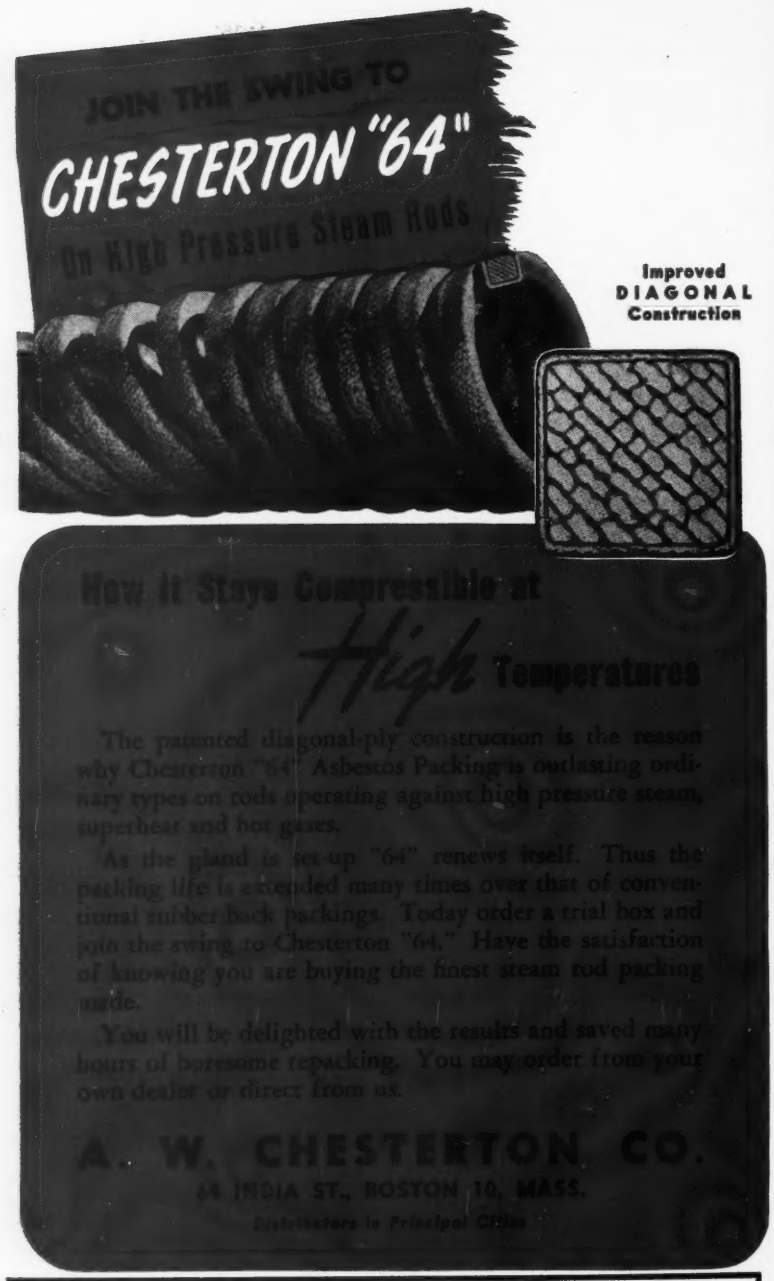
TRADE MARK REGISTERED

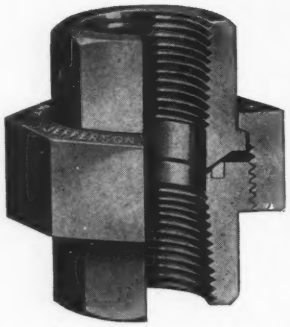
THE LEADER FOR OVER HALF A CENTURY

ENGINEERING SERVICE AND WATER TREATMENT

DEARBORN CHEMICAL COMPANY

Dept. F, 310 S. Michigan Ave., Chicago 4, Ill.


JOIN THE SWING TO
CHESTERTON "64"
On High Pressure Steam Rods
Improved
DIAGONAL
Construction
How It Stays Compressible at
High Temperatures
The patented diagonal-ply construction is the reason why Chesterton "64" Asbestos Packing is outlasting ordinary types on rods operating against high pressure steam, superheat and hot gases.
As the gland is set up "64" renews itself. Thus the packing life is extended many times over that of conventional rubber-back packings. Today order a trial box and join the swing to Chesterton "64." Have the satisfaction of knowing you are buying the finest steam rod packing made.
You will be delighted with the results and saved many hours of baresome repacking. You may order from your own dealer or direct from us.
A. W. CHESTERTON CO.
44 INDIA ST., BOSTON 10, MASS.
Distributors in Principal Cities



The Feature of the RECESSED
BRASS SEAT in the
JEFFERSON UNION
makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

JEFFERSON UNION CO.
601 West 26th St., New York 1, N. Y.

Factories at Lexington 73, Mass., and Lockport, N. Y.

STONE & WEBSTER'S WAR REPORT

IN "A REPORT TO THE PEOPLE," a 150-p book published this week by Stone & Webster Engineering Corp., New York, for a limited distribution, the reader is given new insight into the vastness and complexity of the design, engineering, and construction problems which had to be solved during the war to keep pace with the swiftly changing supply needs of the armed forces and the rush of scientific discovery.

Although intended primarily to be a factual report on how, when and where the corporation designed and constructed over 40 major industrial plants, between the Spring of 1941 and V-J Day, "A Report To The People" also provides a clear, concise, and often dramatic picture of how scientists, designers, construction engineers and industrialists coordinated their efforts to get these plants into full-scale production in the shortest possible time.

PERMUTIT COMPANY ACQUIRES SIMPLEX

THE PERMUTIT CO. has acquired the Simplex Valve and Meter Co., Philadelphia, according to an announcement made recently. H. W. Fould, Permutit's President succeeds W. H. Roth as President of the newly-acquired subsidiary, while Mr. Roth becomes the Simplex Board Chairman.

In making the announcement, Mr. Foulds stated that the Simplex will continue to operate under its own name.

PEABODY ANNOUNCES PLANT CONSTRUCTION

THE PEABODY ENGINEERING CORP., of 580 Fifth Avenue, New York City, announces that construction of additional plant facilities is now in progress at the works in Stamford, Conn.

This construction is part of a long-range expansion program, and is being undertaken now to meet the present demand for Peabody equipment. The new building will be used primarily as a plate and welding shop, and for the assembly of bulky or heavy fabricated products such as air heater or gas scrubber shells and completely prefabricated fuel oil pumping and heating units.

Conveniently located along the New Haven Railroad with ample siding facilities and access to motor transport lines, the tract of land now owned by Peabody is sufficient to allow considerable expansion for future needs at this location. The new building has been designed especially so that additions can be made rapidly without disrupting manufacturing.

TEXACO PUBLICATION CELEBRATES 35TH ANNIVERSARY

THE THIRTY-FIFTH anniversary of The Texas Co. magazine *Lubrication*, a publication devoted to the selection and use of lubricants, is being celebrated. In honor of the occasion the August 1946 issue contains a history of the magazine; a brief biography of its editor, Allen F. Brewer of the Technical and Research Division, who has held the post for almost twenty-five years; and also presents a thirteen page study of hydraulic oils for industrial equipment.

The article includes discussion of maintenance problems and trouble shooting in hydraulic systems, methods of increasing their efficiency, and advantages accruing through the use of additives in these oils. The incorporation of additives in hydraulic lubricants, the publication states, results in oils which aid rust prevention, inhibit oxidation, reduce foaming ,and maintain high standards of viscosity.

B & W DESIGNS THREE HP BOILERS FOR FRANCE

THREE OF WHAT are probably the largest natural circulation high pressure boilers ever to be installed in Paris, and perhaps in France, are being supplied by The Babcock & Wilcox Co. to the Gennevilliers power station of Paris, it was announced recently by the company. The boilers are constructed in the

Production, Prosperity and POWELL VALVES

The real wealth of a nation lies in its power to produce. And the greater the production, the greater the prosperity of its people.

Production depends on many things. Not the least of these is the efficiency of the equipment that controls the flow of the innumerable media that constitute the lifeblood of Industry.

Powell's contribution to national prosperity is a line of valves that is so complete that today there are Powell Valves adapted to *every* service in *every* branch of modern industry.

The Powell Line of Valves for Power Plants includes Bronze and Iron Valves of all required types, sizes, and designs and all types of Cast Steel Valves (including an outstanding line of Non-returns) available in pressure classes from 150 to 2500 pounds. Where quick, positive operation by remote control is desirable, electric motor operators can be furnished.

The Wm. Powell Co., Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

Catalogs furnished on request. Kindly state whether you are chiefly interested in Bronze, Iron, or Cast Steel Valves.

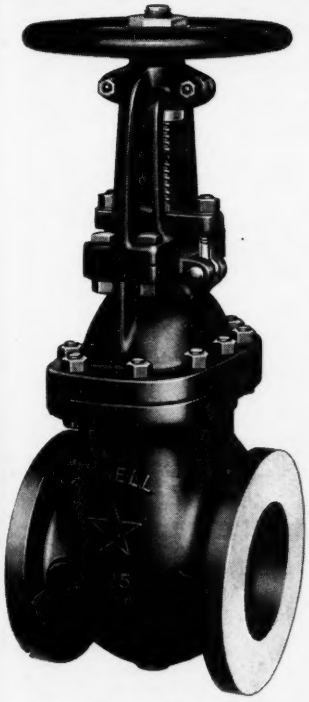


Fig. 1793—125-pound Iron Body Bronze Mounted Gate Valve for 125 pounds W. S.P. In sizes 2" to 30", incl. Has flanged ends, bolted flanged yoke, outside screw rising stem and taper wedge solid disc. Taper wedge double discs can be provided in sizes 2" to 12", incl. Seat rings and stem are in bronze. Disc is bronze in 3½" and smaller size valves; bronze faced in the larger sizes. Also available in All Iron.

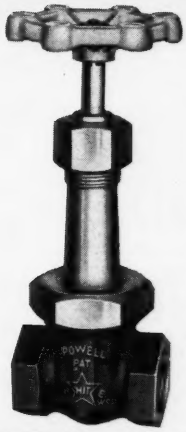


Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze taper wedge solid disc in sizes ¼" to ¾", inclusive; taper wedge double disc in sizes 1" to 3", inclusive.

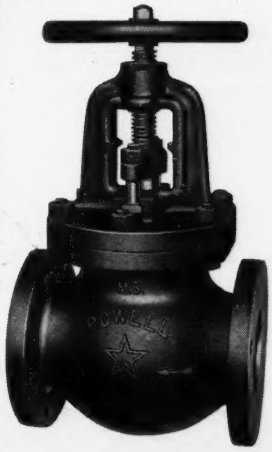


Fig. 241—125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", incl. Has flanged ends, outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc. Also available in All Iron.

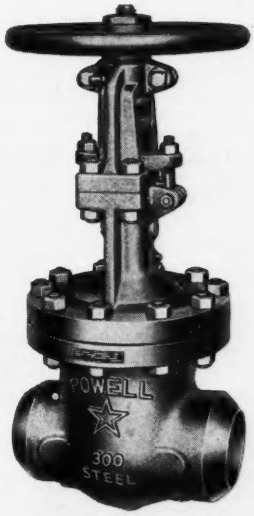


Fig. 3003 W.E.—Class 300-pound Cast Steel Gate Valve with welding ends, outside screw rising stem and bolted flanged yoke.

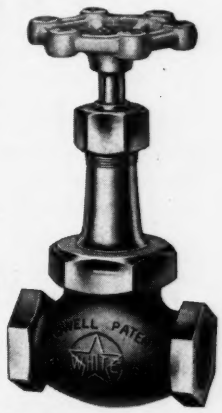


Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable stainless steel seat and regrindable, renewable, wear-resisting "Powellium" nickel-bronze semi-cone plug type disc. Made in sizes ¼" to 3", inclusive.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve. Made in sizes 2" to 16", incl. Has flanged ends bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open permits full unobstructed flow through the valve body. Also available in All Iron.

POWELL VALVES

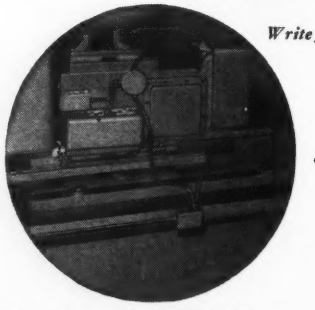
THE NEW
REX MACHINE TOOL CONDUIT
TYPE M. T. C.
. . . by CHICAGO METAL HOSE

C.M.H. is proud to present a new product, built in coordination with the Joint Industry Committee of Plant and Electrical Engineers—in cooperation with the National Machine Tool Builders Association.

CHECK THESE OUTSTANDING FEATURES—
THEN WRITE US FOR DETAILED INFORMATION

- Flexible metal hose liner
- Synthetic cover
- Extremely flexible
- Smoothness of flexible metal hose bore prevents excessive abrasion
- No detrimental abrasive surfaces throughout hose-fitting assembly
- Liquid-tight externally
- Liquid-tight steel fittings—usable with both standard and water-tight conduit boxes
- Fittings are attachable and re-attachable by user—or can be permanently attached at factory
- Sizes from ⅜-in. I. D. to 1½-in. I. D. inclusive
- Furnished in mill lengths or cut lengths, with factory-attached fittings both re-attachable or permanently attached—or with fittings supplied loose for user to attach.

Write for Bulletin M. T. C.—46



Flexible Metal Hose for Every Industrial Use

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS
Plants: Maywood and Elgin, Ill.

company's plant at Barberton, Ohio.

The Gennevilliers plant is one of the six power stations in the vicinity of Paris which provide all of the electric power used in that city. Its capacity is approximately 350,000 kw. The station was operating during the entire period of the war. The one bomb which dropped in the area of the plant did not stop its service.

The power station is located about ten miles from Paris at Gennevilliers on the Seine River. It is one of several power stations owned by the Union d'Electricité which also has hydroelectric stations in the south of France on a power line circuit covering a large area of the country. Recently all French power stations have been nationalized as part of the Electricité de France under government control.

The new equipment which was ordered in July 1945, with initial shipments planned for this Fall, is part of a program of rehabilitation and replacement at the Gennevilliers power station which will encompass nine new boilers and three new turbines.

Canton Stoker Corp., Canton, Ohio, announces the appointment of the Dillon Supply Co., Raleigh, N.C., as sales representatives in central North Carolina for large heavy-duty industrial and commercial stokers. The company also announces the appointment of the M. R. McIntyre Co., Columbus, Ohio, as Ohio sales representatives for their complete line of commercial and industrial stokers and equipment.

American Engineering Co., Philadelphia, recently announced the appointment of the W. K. Sowdon Co., New York, as representative for the Taylor and the Perfect Spread Stokers in eastern New York State. H. M. Lodge, formerly in charge of American Engineering Co.'s New York Office, is now associated with the Sowdon Co. and will handle New York State territory. Also announced was the recent appointment of The Schall Co., Buffalo. N. Y., as sales representative to handle sales in western New York State.

MANUFACTURERS' *Personals*

KUPPER MANAGES LADISH DIVISION SALES

APPOINTMENT OF W. O. Kupper as Manager, Middle Western Sales was announced recently by Fittings Division, Ladish Drop Forge Co. A new office which Mr. Kupper will head has been opened at 332 South Michigan Avenue, Chicago, Illinois.

Mr. Kupper, formerly Manager of Southern Sales for the Fittings Division of the Ladish Drop Forge Co., will direct the sale of the complete line of Ladish seamless welding fittings, forged steel fittings and forged steel flanges in the middle western area.

SUSSMAN AND LANE TO LIQUID CONDITIONING CORP

DR. SIDNEY SUSSMAN, formerly Chief Research Chemist of The Permutit Co., has joined the Liquid Conditioning Corp., 425 West 126th Street, New York City, in the capacity of Chief Chemist.

Marvin Lane, formerly Research Chemist Group Leader with The Permutit Co., has also joined the Liquid Conditioning Corp. He occupies the position of Assistant Chief Chemist.

QUAKER MAKES NEW APPOINTMENTS

IN AN EXPANDING movement in its Fire Hose Department, Quaker Rubber Corp., Philadelphia, has just announced the advancement of two of its present employees. Frank A. Rowe becomes the District Manager of Philadelphia Fire Hose Division, with headquarters at

Do you have any of these CONDENSING or COOLING SERVICES?

- Exhaust steam condensing
- Engine jacket water cooling
- Engine oil cooling
- Gas compressor aftercooling
- Process gas cooling
- Solution cooling
- Quenching oil cooling
- Still reflux condensing
- Final overhead condensing
- Refrigeration system condensing
- Gas treating and purification system condensing and cooling

...if so, look into the FIN-FAN *Air-Cooled* HEAT EXCHANGER

WRITE FOR BULLETIN

Bulletin 1230 fully describes the design, construction and special features of this important development in heat exchangers. Write for your copy today.

Eliminate the complications, problems and expenses of a water supply system . . . assure effective heat transfer at low operating and maintenance cost . . . with the FIN-FAN Exchanger, jointly developed by Fluor Corporation Ltd. and The Griscom-Russell Co.

This sturdily built, widely applicable unit can be mounted on top of existing structures or in limited installation space . . . can be designed for pressures up to 5000 psi and for temperatures up to 1500°F . . . and can perform several different cooling and condensing services in a single installation.

Its many proven advantages warrant your investigation. Complete information sent on request.

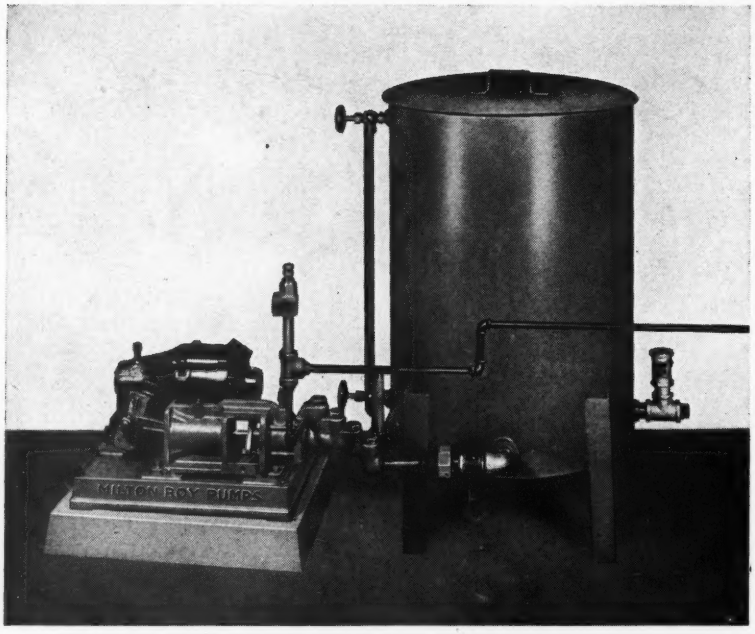
THE GRISCOM-RUSSELL CO.

285 MADISON AVE. NEW YORK 17, N. Y.

GR-113

GRISCOM-RUSSELL

Pioneers in Heat Transfer Apparatus



MILTON ROY
CHEMICAL FEED SYSTEMS
for Boiler Water Treatments

Authorities agree two distinct methods are necessary for chemically treating boiler water. Sodium Sulfite should be fed into the suction side of the feed water pump . . . to remove dissolved oxygen, insure against corrosion and prevent pitting. Other treating chemicals, such as phosphates, soda ash and caustics cannot usually be fed in this manner. Individual chemical feed directly into each boiler is the approved method . . . to prevent scale formation, control alkalinity and prevent embrittlement.

Milton Roy "Packaged Units" are available for both treating methods. For internal treating the unit includes heavy gage welded steel tank, gage glass, low level pump cut-out and alarm, together with necessary pump or pumps. For sulfite feed the unit includes 50 gal. 12 gage welded tank, gage glass, low level pump cut-out, bell alarm, doughnut float and one Milton Roy pump with screw adjustment of stroke.

These "Packaged Units" are available also with electronic control, to continuously operate at a speed proportional to the rate of feed water flow as measured by a standard type flow meter. Fully automatic control is thus obtained, treatments are precisely as required, waste of chemicals is avoided.

For complete description of these systems, with specifications, diagrams, selection tables, etc., write for Bulletin 451. If interested in automatic controls, ask also for Bulletin 468.

MILTON Roy COMPANY
1332 E. MERMAID AVE., CHESTNUT HILL, PHILA. 18, PA.

Philadelphia; and P. H. Penman becomes District Manager of the Cleveland Fire Hose Division, making his headquarters at the Cleveland Branch.

Anouncement is made by Oakite Products, Inc., New York, of the appointment of J. C. Leonard as Sales Manager of its Industrial Marketing Division. Associated with the Oakite organization in the servicing of its specialized cleaning materials and equipment for over 22 years, the last 16 years of which was in the capacity of Manager of the company's Chicago Division, Mr. Leonard assumed his new duties on September 1, 1946.

Edward A. Lowenthal has been appointed Chicago District Sales Manager of the Water Treatment Division of E. F. Drew & Co., Inc. according to a recent announcement from that company.

Announcement is made by Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J., of the appointment of E. L. Alderson as Field Engineer, Oil Field Rubber Products. Mr. Alderson has served for many years as Manhattan's Sales Representative in the Texas and Gulf Coast areas. He will operate as Field Engineer, covering all of the oil fields of the country, making trips to all fields at regular intervals. He will maintain local headquarters at Houston, Tex., but will operate from and as part of Manhattan's Product Engineering Department at its Executive Offices, Passaic, N. J.

Sherman Miller, chief mechanical engineer of the American Locomotive Co., at Schenectady, N. Y., since 1941, has been appointed vice president in charge of Production Engineering, it was announced recently by American Locomotive Co. Raymond J. Finch has been appointed chief mechanical engineer.

Cochrane Corp., Philadelphia, has announced the return of Stuart D. Distelhorst, after almost four years service in the Army, to his position as the company's Sales Promotion Manager. During Mr. Distelhorst's absence, his department was directed by Joseph S. Oldknow, Personnel Manager of the company. Mr. Oldknow continues with layout and production of advertising and other printed matter, in addition to his office of Personnel Management.

Edward B. Heyden has been named to head the construction division of the Graver Tank & Mfg. Co., Inc. Active in construction work since 1920, Mr. Heyden has been associated with The Lummus Co. for the past 14 years. He replaces Lloyd K. Wells, who is retiring to follow personal interests on the West Coast.

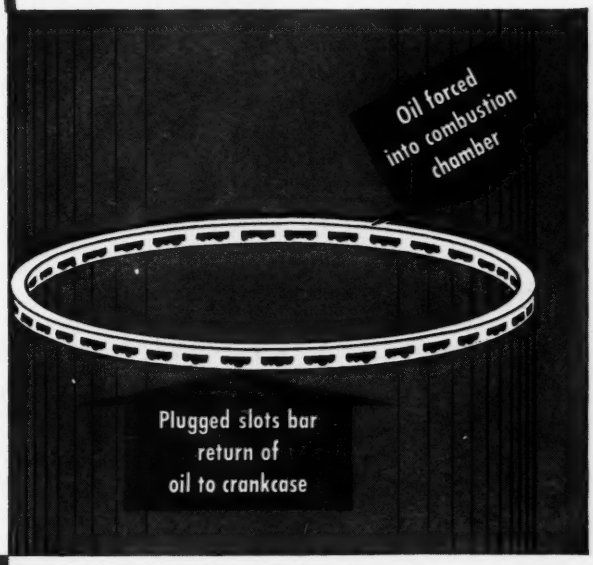
H. J. Harp, treasurer of the National Association of Power Engineers, has joined the Permutit Co. as sales engineer of internal feedwater treatment for the Philadelphia area, according to a recent announcement. Mr. Harp, whose headquarters will be in Permutit's Philadelphia office at 34 South 17th Street, recently served as mechanical engineer for the AAF. Prior to that, he had been Instructor in power plant engineering at the Williamson Trade School, Chief Engineer of the Delaware Jute Mills and Power Chief at Charles P. Lennig, Philadelphia, Penna.

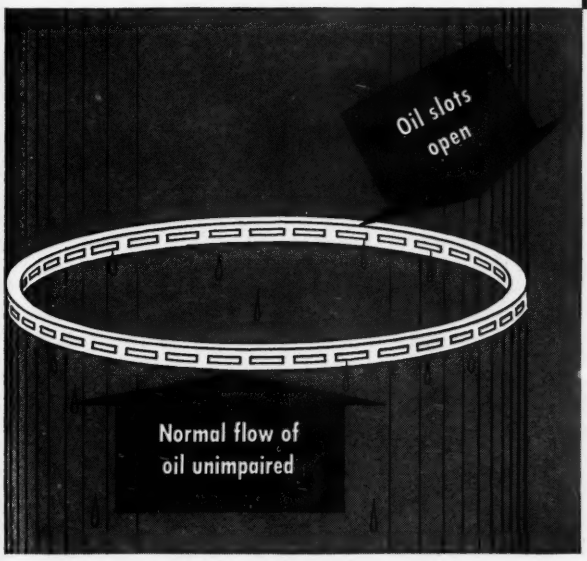
James D. Greensward has been named assistant to William C. Johnson, vice-president of the general machinery division of the Allis-Chalmers Mfg. Co., Milwaukee, Wis. Holder of an electrical engineering degree from Marquette University, Mr. Greensward has been associated with Allis-Chalmers since 1922, starting in the firm's machine shop and working on steam turbine and electrical erecting and testing. In 1936 he was placed in charge of sales of the company's switchgear division and in 1942 he was named assistant manager of the central station and marine department. For the last three years, Mr. Greensward was assistant to the treasurer in charge of contract terminations.

Diesel Engine DANGER points

Plugged Oil Slots Increase Oil Consumption

When carbon and gum formations clog oil-ring slots, the oil which would normally return through these apertures to the crankcase is forced into the combustion chamber. Here it joins the other products of combustion which "coke" on the ring belt area cementing the rings in their grooves and aggravating the clogged condition of the ring slots.





RPM DELO Oil keeps oil slots open, prevents stuck rings

RPM DELO Diesel Engine Lubricating Oil is compounded to prevent engine deposits these three ways:

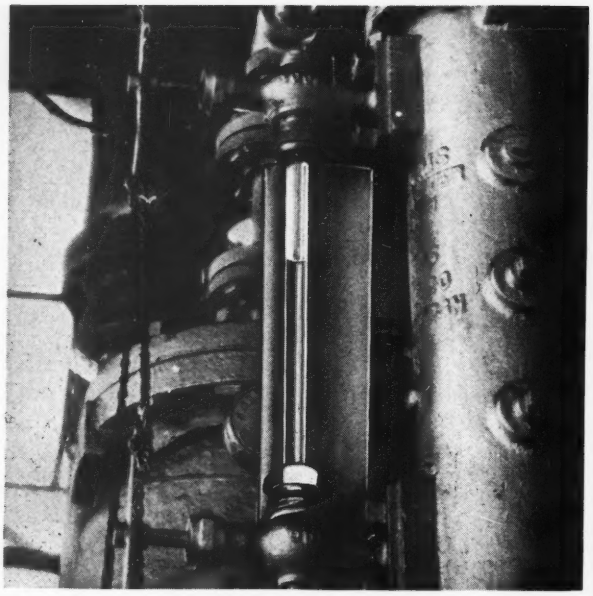
1. An oxidation inhibitor reduces the formation of gummy particles which form the binder for carbon deposits.
2. A detergent prevents deposits forming on rings and pistons, keeping engines cleaner.
3. A dispersive agent insures removal of this material when the oil is drained.

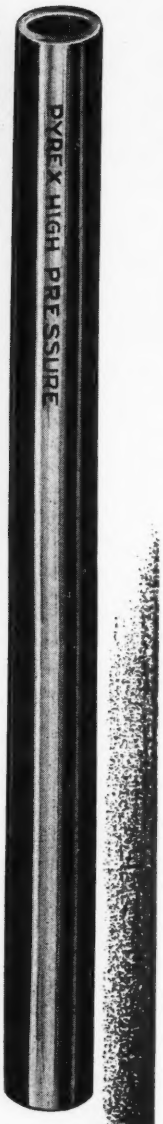
Other compounds in RPM DELO Oil minimize hot-spot wear, prevent corrosion, eliminate foaming.

To match the fine performance of RPM DELO OIL, use these equally efficient companion products from the same famous "RPM" line—RPM HEAVY DUTY MOTOR OIL—RPM COMPOUNDED MOTOR OIL—RPM GEAR OILS AND LUBRICANTS—RPM GREASES. For additional information or name of your distributor, write any of the companies below:

STANDARD OF CALIFORNIA • 225 Bush St., San Francisco 20, California
THE CALIFORNIA COMPANY • 17th and Stout Streets, Denver 1, Colorado
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA OIL COMPANY • 30 Rockefeller Plaza, New York 20

DIESEL ENGINE RPM DELO LUBRICATING OIL





Gauge Glasses TESTED

by Years of Actual Use

Thousands of Pyrex and Corning Gauge Glasses installed years ago are still giving excellent service. Designed and recommended for specific service conditions these gauge glasses are the most economical you can buy.

They are made from glasses that are selected with full recognition of the pressures and conditions under which they are to be used. Machine drawn accuracy permits easy installation and reduces installation strain to a minimum. The smooth, hard surfaces resist abrasion and scratching. They resist the solvent action of hot water and steam. All of these factors mean long, economical, trouble-free performance. Corning Glass Works, Corning, N. Y.

"CORNING" is a registered trade-mark and indicates manufacture by Corning Glass Works, Corning, N. Y.

CORNING Glass Works Corning, New York — Pyrex Gauge Glasses BRAND

Cuts your gasket costs in half

the most remarkable Tool ever invented

Write for Booklet

THE ALLPAX GASKET CUTTER

Manufactured by

THE ALLPAX COMPANY, INC.

Distributors everywhere — *Mamaroneck, N. Y.*

H. S. Brown, chairman of the board and president of Foster Wheeler Corp., has been elected a director of Liberty Mutual Insurance Co.

Corning Glass Works, Corning, N. Y., announces that Richard Rigg has joined the company as a member of the commercial engineering section of the Industrial Sales Department at Corning.

J. E. Fifield, formerly with the U. S. Naval Research Laboratory and the American Brake Shoe Co., has joined the Development and Research Division of The International Nickel Co., Inc. He will make his headquarters at the New England Technical Section of the Division at 75 Pearl Street, Hartford, Connecticut, of which D. A. Nemser is Manager.

Harry K. Collins has been appointed manager of the Resin and Insulation Materials Division of the General Electric Co., it was announced recently. The position was formerly held by the late Edgar L. Feininger who also held the title of assistant general manager of the Chemical Department. Mr. Collins, who was Manufacturing Manager of the division in Schenectady, now assumes responsibility for over-all activities connected with General Electric's new silicone resins, oils, greases, rubber and water repellents as well as its Glyptal alkyd resins and insulating materials.

R. W. Gillmore has been named manager of a new branch office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., opened in the Claremont Hotel Bldg., Evansville, Ind., according to a recent announcement. Mr. Gillmore has been associated with the Allis-Chalmers Indianapolis district office since October, 1935, as sales engineer. He served in the United States Navy from May, 1942, until October, 1945, when he was discharged from active duty as a lieutenant commander.

Skinner Engine Co., Erie, Pa., announces the appointment of H. H. Van Atten as District Sales Representative. Mr. Van Atten has been associated with the company at Erie since 1929, but will now be located at 426-A Temple Bar Building, Court and Main Streets, Cincinnati 2, Ohio.

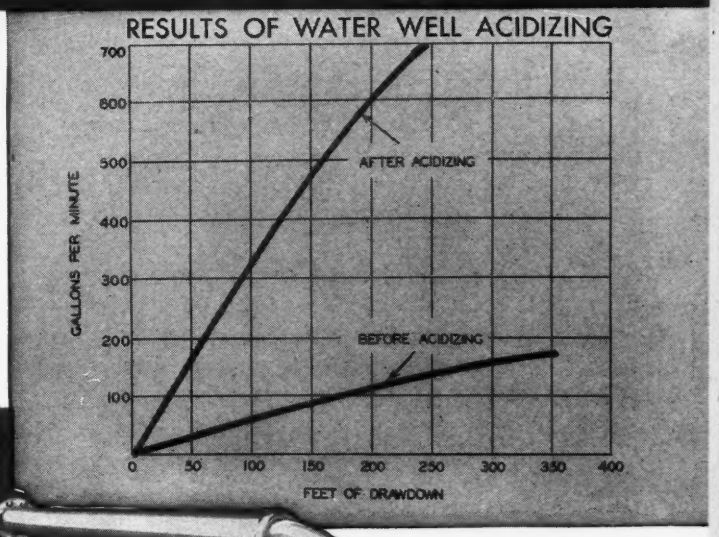
E. A. Tice has joined the Corrosion Engineering Section of the Development and Research Division of The International Nickel Co., Inc., at New York, as a corrosion engineer. He was previously associated with Bethlehem Steel in its Research Department as an engineer in the field of corrosion, and graduated from Rensselaer Polytechnic Institute in 1939 with a BS Degree in Chemical Engineering.

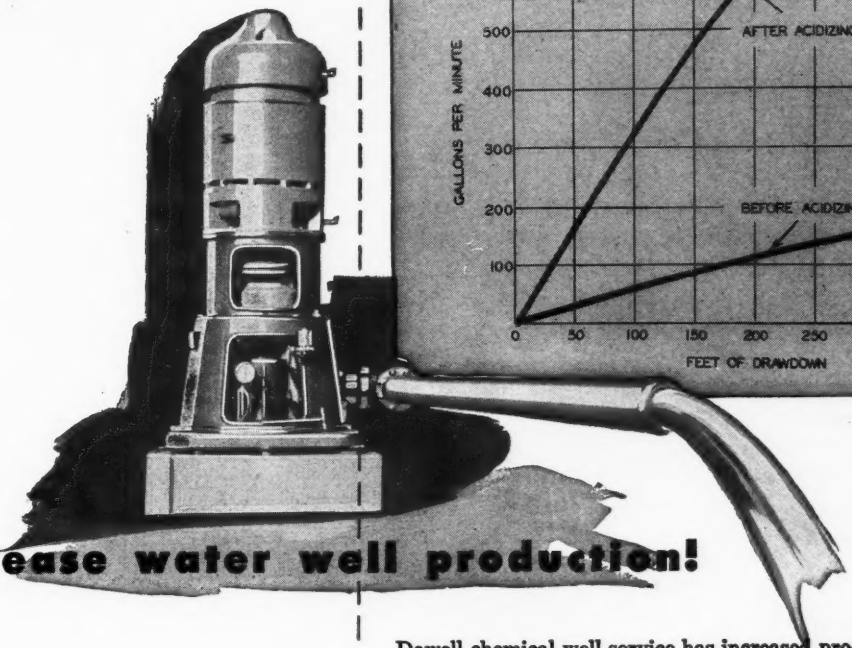
James R. Reed has been named manager of the commercial research department of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., according to an announcement by the company. Other department appointments announced are those of Jerome F. Fitzsimmons as supervisor in charge of research and Anson J. Bennett, Jr., as supervisor in charge of sales analysis. Another announcement reports that Richard F. Muller has been named manager of the New Orleans district office of the Allis-Chalmers Mfg. Co., succeeding F. W. Stevens who after 41 years of service has requested to be released from this responsibility.

The Graver Tank & Mfg. Co., Inc., recently announced the appointment of John E. Fogarty to the post of general manager of the firm's Sand Springs, Okla., plant. He formerly managed the Graver weldment division at the main plant in East Chicago, Ind. Storage tanks and other fabricated plate products are manufactured at the Sand Springs plant.

DOWELL

Drawdown Curves showing the advantages to be obtained from proper chemical treating of water wells.





increase water well production!

Dowell chemical well service has increased production from thousands of water wells. The removal of retarding incrustations on screens and the enlarging of formation pores by chemical treatment permits more water to enter the well bore—and faster!

Dowell pioneered the well-acidizing field and its engineers have the know-how based on years of experience gained in treating thousands of wells. Ask Dowell to analyze your well—restore its production. Call the nearest Dowell office for a free estimate.

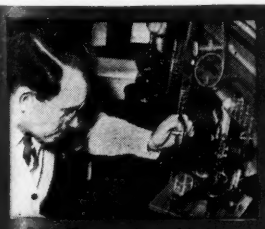
FREE SHOWING! Now available—a new 18-minute sound slide film illustrating the possibilities of Dowell Chemical Scale Removal Service. A Dowell representative will gladly arrange a special showing at your plant, office or organization meeting. Call or write Dowell today.

DOWELL INCORPORATED, TULSA 3, OKLAHOMA

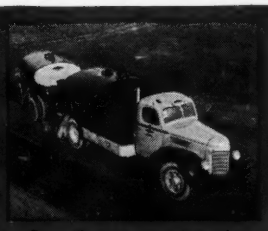
Subsidiary of The Dow Chemical Company

New York • Philadelphia • Baltimore • Buffalo • Cincinnati • Cleveland • Chicago • Detroit
St. Louis • Houston • Kansas City • Wichita • Pittsburgh • Mt. Pleasant, Mich. • Salem, Ill.
Long Beach, Calif., Casper, Wyo.: Dowell Affiliate—International Cementers, Inc.

SPECIALISTS IN CHEMICAL CLEANING SERVICE



Dowell's experienced industrial engineers are backed by the complete research and technical facilities of The Dow Chemical Company.



Dowell's equipment is modern and complete—scientifically designed. Treating stations and chemical warehouses conveniently located.

Dowell cleaning services are "tailor-made" to fit each job. All ingredients are of the highest quality, chosen for best results in your plant.

DOWELL

FOR INDUSTRIAL CHEMICAL SERVI

HELPFUL BULLETINS

(Continued from Page 54)

MAINTENANCE

31 **Corrosion Protection Visual Index**—This is a four page folder which quickly and clearly shows just where, in your plant, to use the company's various protective coating compounds. The inside spread of the folder presents an entire plant drawing—cutaway in some places—with arrows leading from the margin of the page to various surfaces on the drawing. If any of these surfaces have service conditions similar to some found in your plant you have but to read on the margin the type of coating which should be used at this point to provide corrosion protection. Complete descriptions of the various coatings are given and an alphabetical list of the various surfaces presented. Wailes Dove-Hermiston Corp.

32 **Floor Maintenance Problems**—"Tough Floor Problems?" is the title of a new folder dealing with the repair and construction of floors that are subject to acids, greases, oils and severe abrasion. The folder illustrates the method of preventing the disintegration of concrete where these difficult conditions exist. The folder also discusses the patching of spalled concrete, the pointing and resetting of brick or masonry and the repair and construction of foundation and retaining walls. Stonhard Co.

33 **Roof Maintenance**—A new, illustrated folder entitled "Hidden Hazards on Your Roof," has just been published by this company. The folder is a small six-page issue which calls attention to the dangers to machinery and merchandise if leaky roofs are not repaired. The features and characteristics of the company's roof resurfacer are then pointed out and its ease of application is described. Other products in the company's line are listed. Stonhard Co.

34 **Industrial Vacuum Cleaning**—This 4-page bulletin, Form A345 tells a "before and after" story of how vacuum cleaners can save painting and cleaning bills by creating a clean, light plant. Large photos show the results obtained by use of the company's vacuum cleaners and features are listed. U. S. Hoffman Machinery Corp.

35 **Cleaning Compound**—Four pages are included in this Bulletin 1 which is devoted to a description of the advantages of this cleaning compound—Penetone—in industrial plants. The booklet, for instance, shows how heavy de-greasing is accomplished and presents recommended solutions in a "Mulsification Table." The safety of the liquid, its non-toxic and non-inflammable qualities are stressed. The Penetone Co.

WELDING

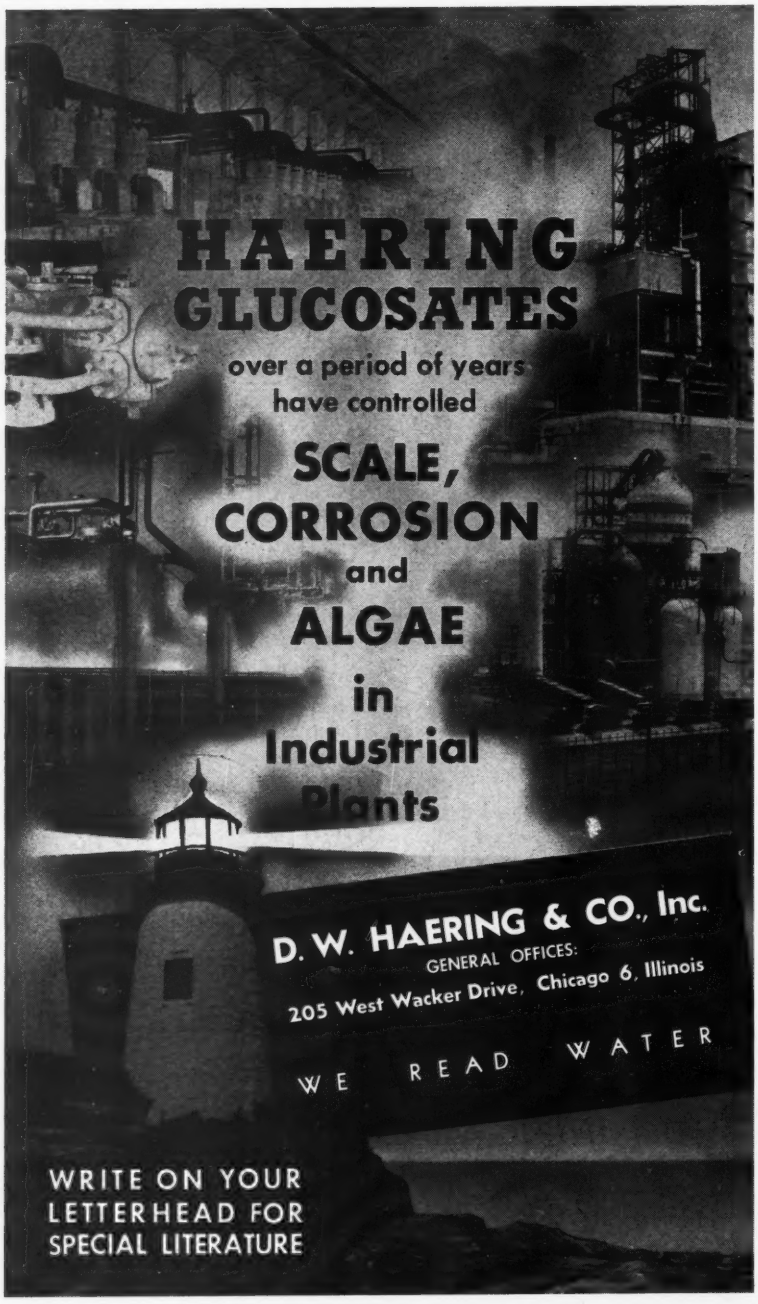
36 **Arc Welding**—Volume IV No. 2 of Hobart Arc Welding News has just been issued. This latest volume tells of the importance of arc welding in the fabrication of API-ASME pressure vessels; describes with photographs and a line drawing an all-welded ash disposal system which is said to greatly speed up this operation; gives a brief description of how one engineer saved $775 and a long delay by arc welding the broken shaft of a Diesel engine. The bulletin contains a short outline of the techniques and practical applications of arc welding as covered in the company's modern trade school and the last two pages are devoted to a continuation of Lessons in Practical Arc Welding which have been appearing in previous issues of the Arc Welding News. The bulletin is extremely well illustrated and also includes a list of books on arc welding which are available from the company. Hobart Bros. Co.

37 **Resistance Welding Electrodes**—20-page Bulletin No. 68A describing Ampcoloy resistance welding electrodes and alloys has just been issued. This bulletin is well illustrated with diagrams and drawings and contains information on a new line of water cooled electrode holders. Included are tables of physical properties of welding alloys; stock sizes and applications; spot welding tips; standard replaceable welding tips; tables of straight water cooled holders, offset water cooled holders, universal water cooled holders, holder to tip adapters, recommended electrode materials, R.W.M.A. Specifications for spot welding similar and dissimilar metals; list of seam welder wheels and shafts and the last two pages contain information on flash, butt and projection welding dies. Ampco Metal, Inc.

INSTRUMENTS, CONTROLS

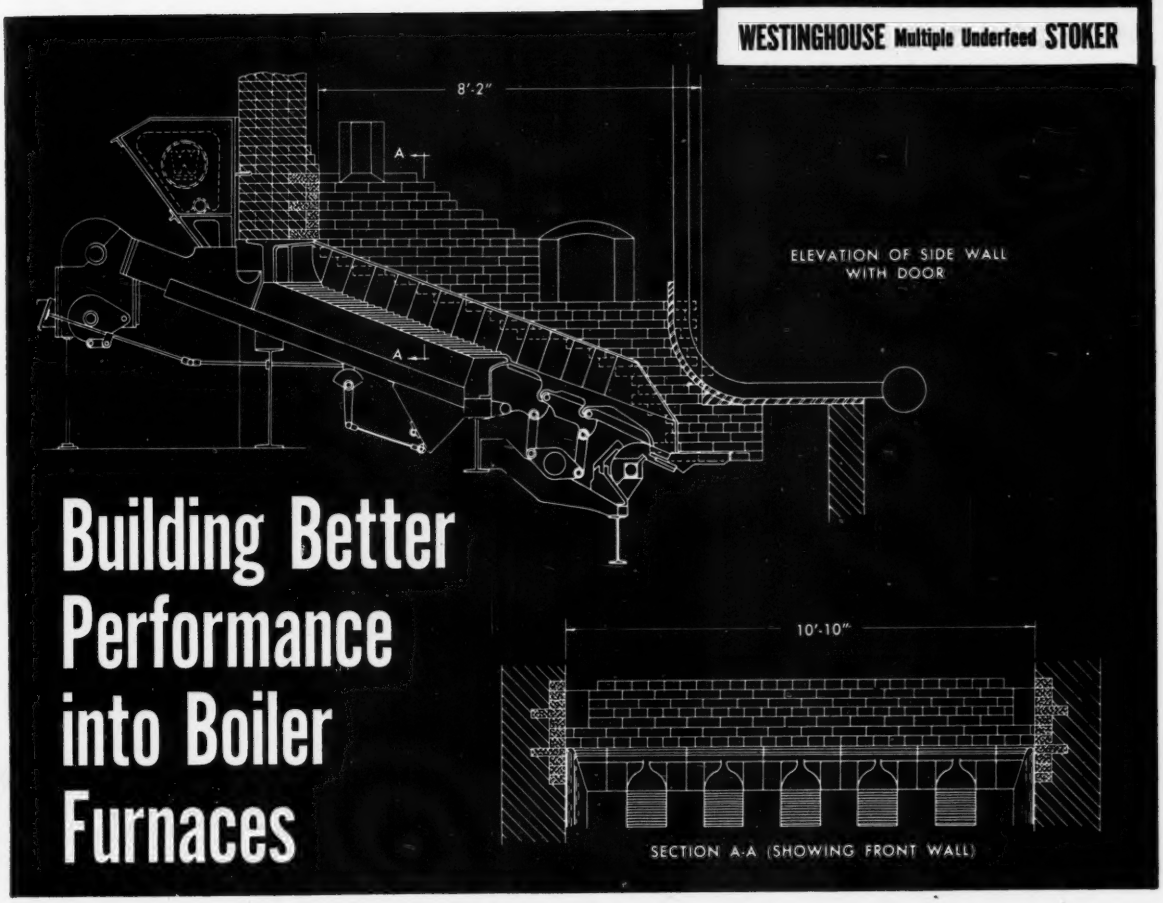
38 **Synchronous Motor Control**—The how, why, when and what of modern synchronous motor control is detailed with more than 45 diagrams and photographs in "The ABC of Synchronous Motor Control," an extremely attractive and informative 20-page booklet in color. The booklet covers the story of "Conscious" synchronous motor control, how the synchronous motor starts, how polarized field-frequency control works; gives spreadout connection diagram, selection chart for control; and describes magnetic full-voltage control, magnetic reduced-voltage control, magnetic part-winding control, and magnetic "Hi-Fuse" combination control. The back cover of the booklet is devoted to some suggestions for the operator on how to keep control in good condition. Electric Machinery Mfg. Co.

39 **Oxygen Indicator**—This company's oxygen indicator for measuring oxygen content of gaseous mixtures for combustion and process control and for improving the safety of utility operation



WALL BRICK DATA

WESTINGHOUSE Multiple Underfeed STOKER



Building Better Performance into Boiler Furnaces

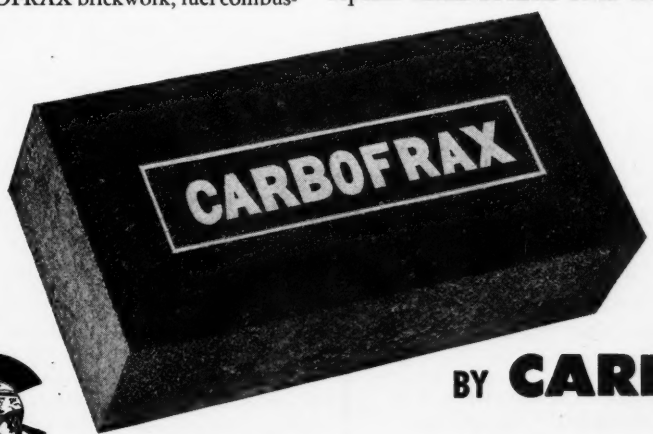
CARBOFRAX silicon carbide lining constructed to specified design for use with a Westinghouse stoker assures more low cost steam with less trouble. Individual operating characteristics of the furnace will, of course, determine the height of CARBOFRAX lining required for maximum efficiency.

In any furnace installation utilizing CARBOFRAX brickwork, fuel combustion is improved. The entire grate area is available at all times. Greater steaming capacity is attained. That is because draft choking clinkers can not cling to the hard dense surface of a CARBOFRAX lining. Even at temperatures far above those normally encountered, this clinker resistance is retained.

There are few if any outages for lining repairs. CARBOFRAX brick stoutly resist mechanical abrasion, spalling and cracking. Maintenance expense is practically non-existent. Continuous uninterrupted production adds still more to available capacity.

Built to last, CARBOFRAX brickwork regularly is reported on the job for 8, 10 and more years. Upper walls give more service too because they are firmly supported on a foundation that does not burn or cut back.

To realize better performance from your boiler furnaces, look into all the advantages of CARBOFRAX settings. Pertinent facts are clearly set forth in "CARBOFRAX in Boiler Furnaces," a copy of which is yours for the asking. We will be glad to supply more detailed information at your convenience. Write Dept. H-116, The Carborundum Company, Refractories Division, Perth Amboy, New Jersey.



BY CARBORUNDUM
TRADE MARK

"Carborundum" and "Carbofrax" are registered trademarks which indicate manufacture by The Carborundum Company

and controlling pipe line corrosion is described in this 4-page Bulletin DW-3. Applications of the indicator are first covered and then a section titled, "A Few Simple Rules of Maintenance," is presented. Mine Safety Appliances Co.

40 **Instruments Bulletin**—Bulletin 359 is a four page issue which illustrates and briefly describes the company's recording, indicating and controlling instruments. Included are descriptions of such items as shuntflo meter, venturi tubes, venturi insert nozzle, chronoflo telemeters, orifice plates and flanges, etc. Builders-Providence, Inc.

41 **Water Level Control**—Bulletin 459 contains 8 pages and is concerned solely with the story of water level control at Wyman-Gordon Co. plant in Harvey, Ill. The bulletin is excellently illustrated and presents a table of significant data and reproductions of typical flow meter charts and recorder charts. Northern Equipment Co.

REFRIGERATION

42 **Fin Coils, A.C. Data Book**—Concise, clear tables and complete refrigeration data as well as complete engineering information are contained in this new illustrated catalog No. 120. This bulletin covers the company's fin coils and custom built air conditioning units for low temperature cooling. It has just been published. Refrigeration engineers will find this catalog of distinct value as an aid in selecting proper coils and for such installations as walk-in coolers, air conditioning, etc. Specific information as to fin space, number of coils required, surface in square feet, Btu capacity per hour per degree, and to many other factors are included. There are 20 pages in the bulletin. Rempe Company.

RODA

High grade gas, by-product and steam coal from Wise County, Va., on the Interstate Railroad.

DENDRON

High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA

High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX STOKER

A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

COKE

Roda and Stonega from Wise County, Va., and Connellsville Coke from Pennsylvania.

CRITERION COAL

High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

CROZER

Genuine Third Vein Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railroad.

LYNCO

Medium volatile, high fusion coking coal for by-product and steam use from Wyoming Co., W. Va., on Vgn. Ry.

Old Kentucky

Hazard No. 4 and No. 7 steam and domestic coal from Wiscoal, Knott County, Kentucky, on the L. & N. Railroad.

CHARMCO

Unexcelled Steaming Coal from the Fire Creek Seam in Greenbrier County, W. Va., originating on the N. F. & G. R. R.

ANTHRACITE — Hazle Brook Premium . . . Raven Run

General Coal Company

123 SOUTH BROAD STREET, PHILADELPHIA 9, PA.

BRANCHES:

BLUEFIELD, W. VA. BOSTON BUFFALO CHARLOTTE, N. C.
CINCINNATI DETROIT NEW YORK NORFOLK PITTSBURGH

43 **Freon Water Coolers**—This is a 12-page bulletin describing a new improved dry expansion water cooler. The bulletin is attractively illustrated with blueprint drawings and a two page cooler selection data chart made highly useful by the liberal use of colored stripes. Included in the bulletin are standard construction specifications, instructions for selecting water coolers, a direct reading log, mean temperature difference table, a table of suction and liquid line sizes and a table of recommended water line sizes. The Patterson-Kelley Co., Inc.

MISCELLANEOUS

44 **Flexible Couplings** — This is a triple-fold bulletin which sketches types of couplings in the company's line. The operating principle of the entire line of couplings is shown by means of descriptive matter and line drawings. The coupling line is listed and illustrated. Thomas Flexible Coupling Co.

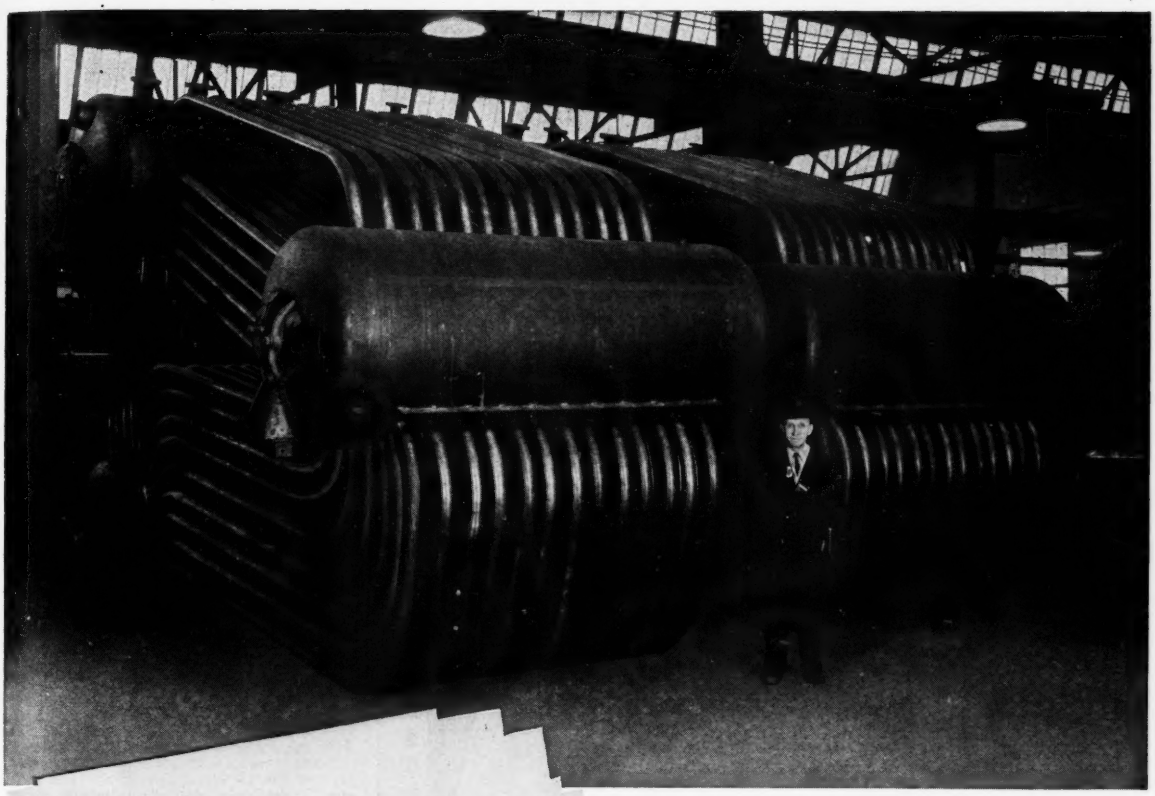
45 **Pocket-Size Saw Book**—This booklet is a 32-page, pocket-size booklet covering suggestions and hints for proper selection and use of hand and power hack saw blades and flexible back band saws. For instance, one section of the booklet shows the right and wrong methods of sawing different shapes of metal with "right and wrong" illustrations. Up-to-date specifications and price lists are given. Other sections are "Correct Use of Hand-Operated Hack Saw Frames," and "Causes of Common Difficulties." The booklet is extremely well illustrated. Clemson Bros., Inc.

46 **Industrial Insulations Booklet** — There are 16 pages in this bulletin on industrial insulations. The insulations are designed for temperatures from minus 300 F to plus 2800 F. The efficiencies of the company's line of insulations are discussed and its engineering service is explained. The next several pages are devoted to detailed descriptions of the types of insulation—pipe insulation, blocks and lagging; combination pipe and block insulation; air cell insulation; hair felt; non-frost and non-sweat pipe insulation. Other heat insulation and cork covering for all cold lines are described, too. Tabular material includes several tables of heat insulation packing data, list prices per linear foot of sectional pipe insulations, list prices for standard sheet and block insulation. Armstrong Cork Co.

47 **Condensate Return System Data Book**—Publication No. 3250 is a 16-page booklet telling about this company's condensate return system "for increasing heat transfer rates in steam process equipment." Description and listing of advantages of the unit are followed by a well-illustrated section "How the Jet Works," and drawings of a typical illustration. Proven results of the system are covered in a two-page spread complete with diagrams and sketches. Two other pages are devoted to a large drawing of the system with a table of dimensions accompanying it. Then case studies of how better heat in various industries resulted in increased production and lower costs. A selection chart and list of specifications are given on the back page of the booklet. Cochrane Corp.

48 **Self-Fluxing Solder** — Here is a four-page bulletin describing this new self-fluxing solder called Tri-Core. The bulletin points out the advantages of the three cores of solder which are said to give the correct amount of flux in order to make a perfect joint. The control of the flux and the flux efficiency are described. The bulletin also briefly describes other products on the company's line such as extruded shapes, sheet and strip, lead and tin specialities, preforms, etc. Alpha Metals, Inc.

49 **Information on Metallizing**—The October issue of Metco News tells how metal spraying did the following



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jobs: Saved $1500.00 to $2,000.00 in the restoration of main bearing journals of a large ammonia compressor. Avoided a three-week shutdown of a main boiler system by rebuilding in 50 hr the worn section on the shaft of an induced draft fan. Reconditioned a 1500 hp horizontal turbine by building back to size the bronze seal rings, water vane shafts and bucket corners. Metallizing Engineering Co., Inc.

50 **Fluid Progress**—Illustrative of the company's skill in designing, fabricating and erecting piping and similar installations is the booklet "Fluid Progress" issued recently. It shows one complete history of an installation for fluid catalytic cracking and how the system operates. The complete process is illustrated in exceptional detail and clarity by the use of three color illustrations and many photos and sketches. The M. W. Kellogg Co.

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions dictated by space requirement or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

PRIME MOVERS

51 **Wheel Turbines**—Explanation of 14 advantages; diagrammatic illustrations and explanations of operation; 8 pages. Terry Steam Turbine Co.

52 **Axial Flow Impulse Turbine**—Bulletin S-107; six types described; data for estimates; applications; types, casings; wheels and blades; shafts, nozzles and bearings; overspeed stop and other governor features; lubrication; 8 pages. Terry Steam Turbine Co.

53 **Multi-Stage Turbine** — Bulletin SR-114; Casing, lagging, wheels and blades; shafts, nozzles, bearings; governors; speed changer or synchronizer; governor valve and steam strainer; lubrication; general; 10 pages. The Terry Steam Turbine Co.

54 **Steam Engines** — Bulletin No. 306; Engineering data; tabular material descriptions; 8 pages. Troy Engine & Machine Co.

55 **Generating Sets** — Bulletin No. 108; General descriptions, typical installations, engineering data tables, details of construction, completely illustrated; 24 pages. Troy Engine & Machine Co.

STOKERS

56 **Stoker**—Catalog H; Type H stoker; cross-sectional installation drawing; features of ash discharge; typical installations; 10 pages. American Engineering Co.

57 **Air-Cooled Stoker**—Catalog R-A; features of construction; how timing device works; installation drawings, ash discharge, air cooling features; features of front end driving mechanism; engineering data tables; 20 pages. American Engineering Co.

58 **Water - Cooled Stoker** — Catalog W; drawings of installations; features; furnace views; 8 pages. American Engineering Co.

59 **Spreader Stoker**—Installation views; features of various parts; cross-sectional view of furnace with installation; listed features; 8 pages. American Engineering Co.

60 **Pneumatic Spreader Stoker**—Threefold booklet on the inner page of which there are 30 spirally-bound vertical pages which fold back to tell the story of the stoker, installation, features, construction, principles, engineering, types and models, typical installations; well illustrated; 33 pages. Iron Fireman Mfg. Co.

61 **Poweram Stoker**—Bulletin 7121; essentials of successful stoker; fuel control, fuel conveying, fan capacity, controls, installation; illustrations; 18 pages. Iron Fireman Mfg. Co.

OIL, GAS BURNERS

62 **Oil Burning Systems**—Bulletin 45-1; three types of systems; drawings, tables of capacities and descriptions; photos; 4 pages. Faber Engineering Co.

63 **Mechanical Oil Burners** — Bulletin 45-2; two systems; drawings, tables of capacities and descriptions of units; parts list; 4 pages. Faber Engineering Co.

64 **Oil and Gas Burners**—Bulletin 45-3; combination burner; photos, drawings, tables; 4 pages. Faber Engineering Co.

65 **Wide Range Oil Burning System**—Bulletin 109; How the system operates; control; drawings; 4 pages. Peabody Engineering Corp.

66 **Oil Burners**—Bulletin 108; Two types of oil burners, A and H; air registers, oil atomizers, drawings; 4 pages. Peabody Engineering Corp.

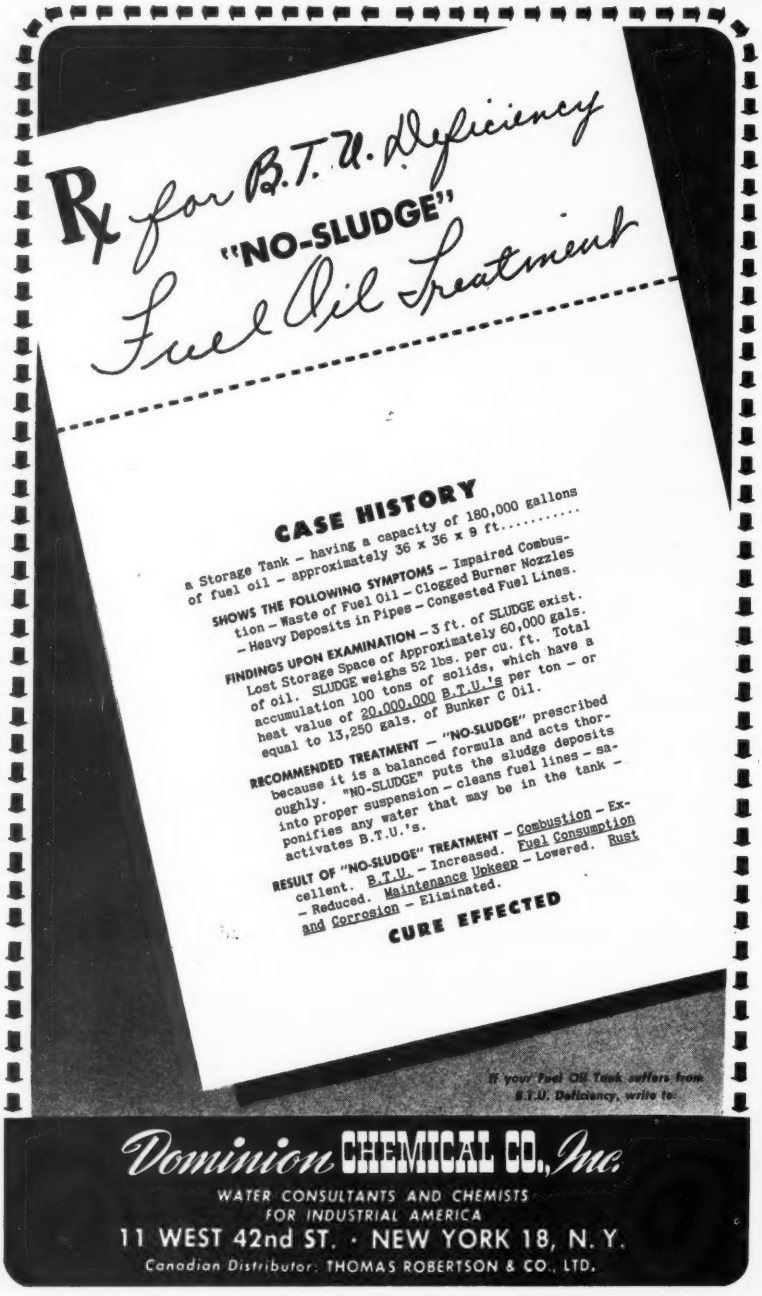
67 **Gas Burners** — Bulletin 203; description of A and H gas burners; cross sectional diagram; photos of atomizers; 4 pages. Peabody Engineering Corp.

68 **Gas and Oil Burners for Oil Refinery Furnaces**—Bulletin 702; details of firing with gas, with oil; photos; drawings; 4 pages. Peabody Engineering Corp.

WATER TREATMENT

69 **Water Treatment**—Control of Fouling Organisms in Fresh and Salt Water, by John G. Dobson. Life history of these organisms; method of control. Wallace & Tiernan Co., Inc.

70 **Industrial Water Treatment**—Microbiological Control of and Through Industrial Waters; spot summaries of im-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CASE HISTORY
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FINDINGS UPON EXAMINATION – 3 ft. of SLUDGE exist. Lost Storage Space of Approximately 60,000 gals. SLUDGE weighs 52 lbs. per cu. ft. Total accumulation 100 tons of solids, which have a heat value of 20,000,000 B.T.U.'s per ton – or equal to 13,250 gals. of Bunker C Oil.
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RESULT OF "NO-SLUDGE" TREATMENT – Combustion – Excellent. B.T.U. – Increased. Fuel Consumption – Reduced. Maintenance Upkeep – Lowered. Rust and Corrosion – Eliminated.
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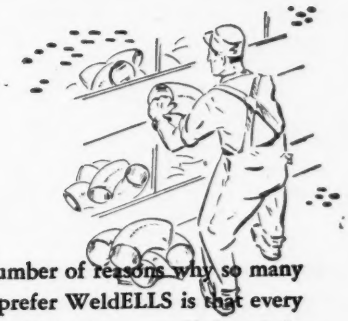

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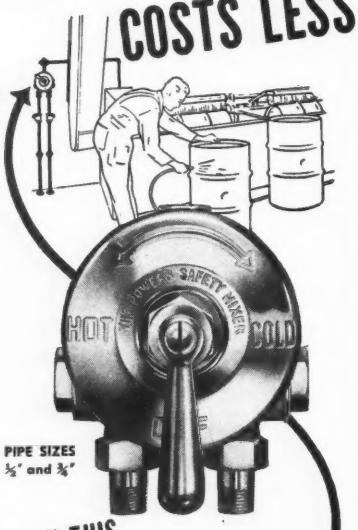

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71 **Condenser Water Treatment**—Chlorination of Condenser Cooling Water, by R. B. Martin; important considerations in chemical treatment of cooling water circuits. Wallace & Tiernan Co., Inc.

72 **Water Treatment**—Chlorine Destroys Ammonia, by A. E. Griffin. Gives data on use of chlorine for elimination of ammonia from boiler feed water. Wallace & Tiernan Co., Inc.

73 **Index for Calcium Carbonate** — Reprint of paper by John W. Ryznar; tables and charts; 16 pages. National Aluminate Corp.

74 **Water Treatment**—Bulletin 28S; Scale retardent for use in boilers, feedlines, heaters, etc.; drawing of points of application; composition; 4 pages. National Aluminate Corp.

75 **Boiler Feedwater Q & A**—Bulletin 30; 102 questions and answers on various problems of boiler feedwater; 16 pages. National Aluminate Corp.

76 **Water Analysis**—Bulletin 6A; standard methods of water analysis and interpretation of results; 4 pages. National Aluminate Corp.

77 **Water Treatment**—Scale and corrosion control in potable water supply; reprinted paper presented by Hanlon, Steffen, Rohlich and Kessler; 12 pages. National Aluminate Corp.

78 **Algae and Slime**—Bulletin 31; the elimination of algae and slime in cooling systems, paper mills, etc., drawings, photos; 4 pages. National Aluminate Corp.

79 **Chemical Feeding and Proportioning** —Bulletins 1100 and 1713A; use of adjustable chemical feeder for water treating, sewage, chemical processes, petroleum; plan and sectional diagrams; descriptions; photos; general specifications; 2-page table of capacity schedules; list of chemicals handled; accessories; drawings of boiler water conditioning systems; 5-page description of method of automatic intermittent feed of conditioning chemicals direct to the boilers; 20 pages. Proportioneers, Inc.

80 **Water Treatment** — Various types of water treating; corrosion, carry-over; boiler scale; flexibility; rust prevention; brine treatment; softening and coagulation; cooling and condenser water; chart of treatment in various industries; 24 pages. Western Chemical Co.

81 **Water and Steam Treatment** — Two bulletins on Algaecide and Coravol; when and where algaecide should be used; tells how Coravol operates in the steam system; features and advantages; testimonials; 9 pages total. Western Chemical Co.

82 **Water Softeners**—Bulletin 607; benefits and economies of soft water; typical applications; how it works; types; design and features; backwash and brine rinse regulators; how to modernize present softener; aerators, degasitors, chemical feed systems, chemicals; 20 pages. Elgin Softener Corp.

POWER TRANSMISSION

83 **Chain Drives**—Bulletin 43 Engineering Data; installation and maintenance; chain types; sprocket types; drive design; horsepower capacity; shoes and idlers; sprocket diameters; miscellaneous data; directions for cutting sprockets; electric motor shaft data; illustrations, complete indexing; 82 pages. Morse Chain Co.

84 **Roller Chains—Catalog R44**; installation; chains and parts; chain drive layout; power transmission capacity tables (10); calculation of chain length; sprocket diameters; dimensions of teeth; 94 pages. Morse Chain Co.

85 **V-Belt Drives**—For fractional horsepower service; features; full pages of tabular material and directions on selecting proper drive; reference table on standard pulley combinations in sequences of pulley sizes; overloads and peak loads, general engineering data; prices and dimensions; 42 pages. The Dayton Rubber Mfg. Co.

86 **V-Belt Drives** — Catalog 280-A; 15 pages on V-belt drives for standard motor speeds; 41 pages on V-flat drives, how to select, advantages; nine pages on supplementary drive tables; 13 pages of engineering data; 16 pages prices and dimensions; total 112 pages. The Dayton Rubber Mfg. Co.

87 **Speed Reduction, Increase Gear**—Bulletin S130; description; gear cases; gear and pinion; bearings; lubrication; drawings and photos; 8 pages. The Terry Steam Turbine Co.

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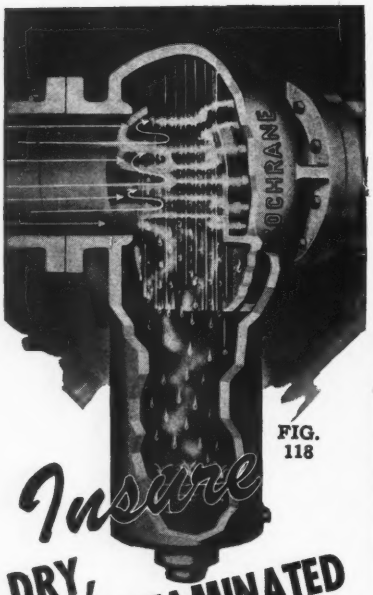

FIG. 118

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89 **Pressure Regulator—Bulletin 1-B;** description, installation, operation; list prices; sectional and installation views; parts lists; 8 pages. Atlas Valve Co.

90 **Pressure Reducing Valves — Bulletin 1-C;** sectional drawings, list prices, dimensions and weights; operation and adjustment; capacities for steam and air; 12 pages. Atlas Valve Co.

91 **Float Valves, Liquid Level Controls—Bulletin 3;** description and list of parts: price lists; operation; adjustment; application and utilization; installation drawings; 8 pages. Atlas Valve Co.

92 **Pressure Reducing Valves — Bulletin 401-A;** selection of proper valve; construction; installation; capacity tables; interchangeability; dimension tables; 14 pages. Leslie Co.

93 **General Service Valves—Bulletin E-150;** valves for blow-off; fire protection, soot blower lines, acids, process, etc.; descriptions; exploded views; features; dimensions, weights and list price tables; parts and parts lists; 14 pages. Everlasting Valve Co.

94 **Valves — Bulletin E-100;** for boiler room service; photos, descriptions, parts; features; pressure rating indexes; size, shipping weight and price tables; ordering information; 30 pages. Everlasting Valve Co.

SWITCHGEAR

95 **Switchgear—Bulletin 4508;** conversion factors and formulas for electrical engineers; definitions of basic units; mensuration conversion factors; temperature conversion factors; electrical conversion factors; 8 pages. I-T-E Circuit Breaker Co.

HEATING, COOLING

96 **Cooling, Heating, Air Conditioning—** Collection of bulletins; installation, design, construction data, capacity ranges, condensed physical data; numerous photos of installations, full page color diagrams of flow of air, compressed air, water, water spray, etc.; 74 pages. Niagara Blower Co.

97 **Steam Conduit System—Bulletin 381 and 451;** tells of foundation, drainage and insulation features; covers tile envelope, pipe insulation, pipe supports, anchors, guides and saddles; photos of installations; 12 pages. H. W. Porter & Co.

98 **Fin Tube Heating — Bulletin 11sa;** Room and building heating; edr tables; correction table; dimensions and areas; 4 pages. Schutte & Koerting Co.

OIL, LUBRICATION

99 **Lubrication Recommendations—Special** oils for diesels and heavy-duty gasoline engines; facts about oil; tables of recommended oils for various models; 18 pages. Standard Oil Company of California.

100 **Cutting Fluids—Facts about cutting fluids:** machine tool operations: fundamentals of cutting; how to apply; metallic cutting tools; tabular material; shop practices; 50 pages. Standard Oil of California.

101 **Diesel Operation — Relation of fuels and lubricants to the operating efficiency in the diesel engine;** diesel fundamentals; maintenance; lubrication and fuels; supercharging; selection and classification of fuels; fuel injection maintenance; improving cleanliness; tabular material, charts, formulas; 114 pages. The Texas Co.

102 **Engineers Report on Oil — Engine tests,** laboratory tests, effects on engines, bearing corrosion, actual service data, filter clogging, service experience; well illustrated with photos and charts; 42 pages. Standard Oil Company of California.

CONTROLS, METERS

104 **Pressure Controllers — Bulletin 402;** air, gas, steam or water service; when to use; selecting diaphragm regulating valve; sizing and capacity; operation; installation; ordering; specifying; dimensions; diaphragm regulating valves; 12 pages. Leslie Co.

105 **Pump Governors — Bulletin 403-A** reciprocating, turbine-driven, motor-driven pumps; selection of governor; construction; pressure, capacity tables; installation; sizing; specifying; dimensions; 12 pages. Leslie Co.

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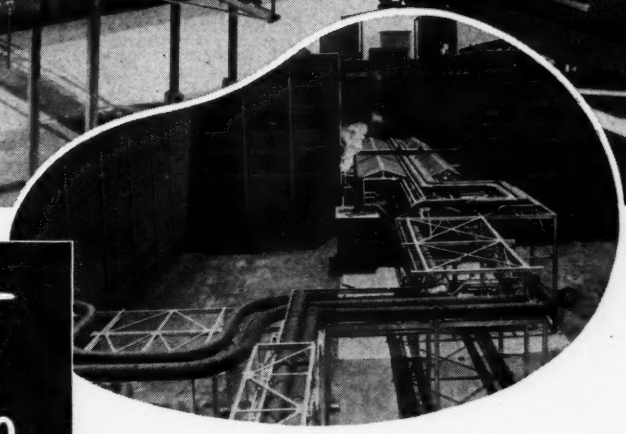

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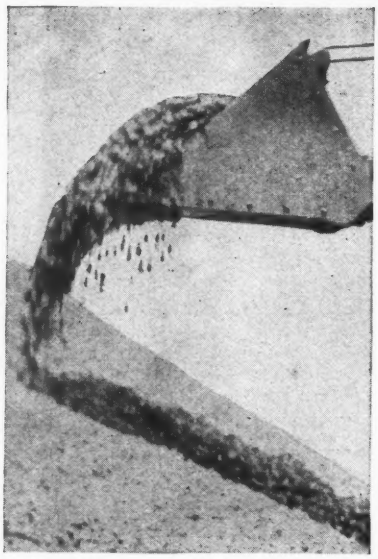
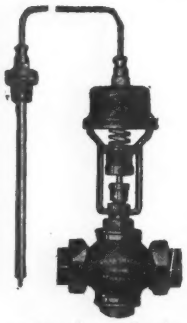


How much of this good coal will be wasted?



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25%?

50%?

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106 **Temperature Regulators — Bulletin 404-A;** heating or cooling service; selection of regulator; temperature and pressure ranges; installation; various types described and pictured; ordering and specifying; complete tabular material; 16 pages. Leslie Co.

107 **Damper Regulators—Bulletin 4-A;** for low pressure heating, medium pressure power and high pressure power boilers; what they do; how to specify; typical installations (drawings); adjustments; list prices; technical descriptions and parts lists; 20 pages. Atlas Valve Co.

108 **Pump Governors — Bulletin 2-B;** photos, descriptions, list prices, dimensions and weights in tables; operation and adjustment; installation drawings; 20 pages. Atlas Valve Co.

109 **Engineering Monographs — Series of** eight on automatic combustion control; 1. How Close Can Steam Pressure Be Controlled? 2. Why Operate Automatic Combustion Control from Changes in Steam Pressure? 3. Adapting to the Characteristics of Underfed Stokers. 4. Adapting to Spreader Type Stokers. 5. Adapting to Chain or Traveling Grate Stokers. 6. Adapting to the Characteristics of Pulverizers. 7. Adapting to the Characteristics of Oil Burners. 8. Adapting to the Characteristics of Gas Burners; total 37 pages. The Hays Corp.

110 **Draft Gages—Bulletin 46-667;** gages for indicating, recording of drafts, pressures, differentials, temperatures; pressure-draft tables; descriptions of equipment; differential units, Bourdon tube units, pointer gages, etc.; 20 pages. The Hays Corp.

111 **Draft — Bulletin 46-472;** what draft is; where it is found; how it is measured; what the draft gage tells; where to measure draft and pressure in steam plant; where to connect draft gages; how to install; drawings; 20 pages. The Hays Corp.

112 **Pointer Gages—Bulletin 45-589;** where and how to install pointer gages; engineering data, drawings; 8 pages. The Hays Corp.

113 **Air Filter Gage—Bulletin 46-751;** resistance through filters; price and scale range tables; types of gages; 4 pages. The Hays Corp.

114 **Flue Gas Analyzer—Bulletin 45-668;** principle of operation; construction features; technique; models and prices; Burettes—classifications and uses (table); what flue gas analysis tells us; 16 pages. The Hays Corp.

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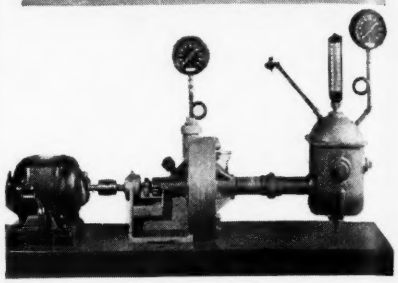

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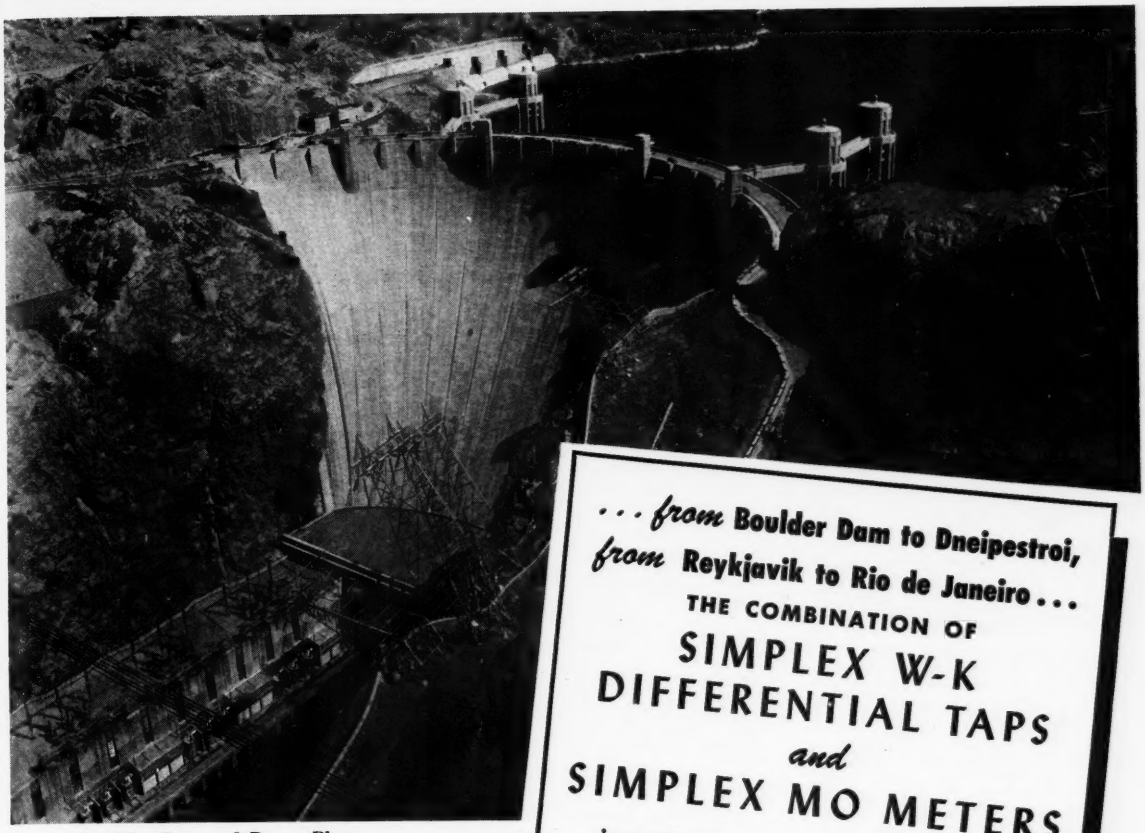

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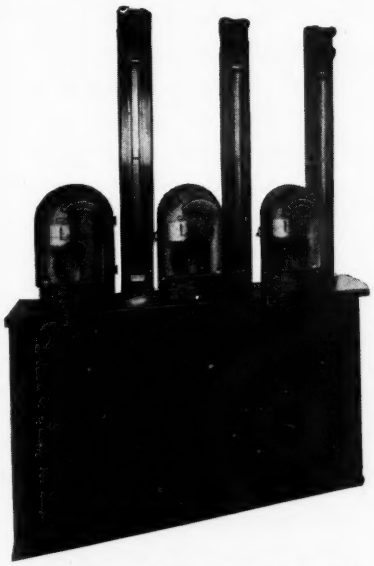

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Silicone News

DC

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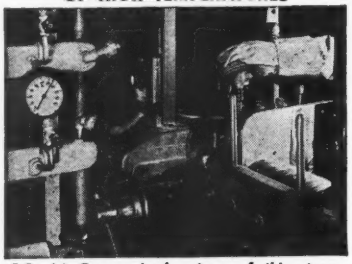
KEEP MACHINES RUNNING IN SPITE OF HIGH TEMPERATURES



DC 44 Grease in bearings of this steam heated two roll mill gives effective lubrication at 300°F. In this application complete freedom from bleeding is essential because any oil on the rolls ruins the material being milled.

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Additional information about DC Silicone Greases is contained in data sheet No. M 7-1.

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125 **Flow Indicators**—Bulletin 18W; what they are; three types; applications; line drawings; table; 4 pages. Schutte & Koerting Co.

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128 **Propeller-Type Meter**—Bulletin 350A; for main-line metering; applications, description, installation, materials of construction; features; table of capacity, shipping weights; specifications, drawings; 4 pages. Builders-Providence, Inc.

129 **Feedwater Textbook** — "Mechanical Feedwater Regulation for Boilers" by Prof. E. P. Culver; principles of feedwater regulation; mechanical equipment available; differential pressure control; feed pump control; illustrations, diagrams, charts; 36 pages. Northern Equipment Co.

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132 **Packings**—Bulletins P3, P14, P25 and P22; descriptions, tables of size and size number; tables of service for various packings; prices; 18 pages total. Greene, Tweed & Co.

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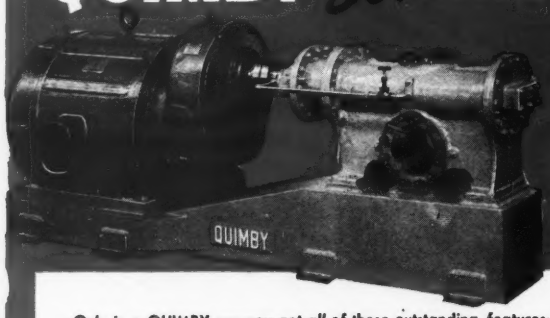

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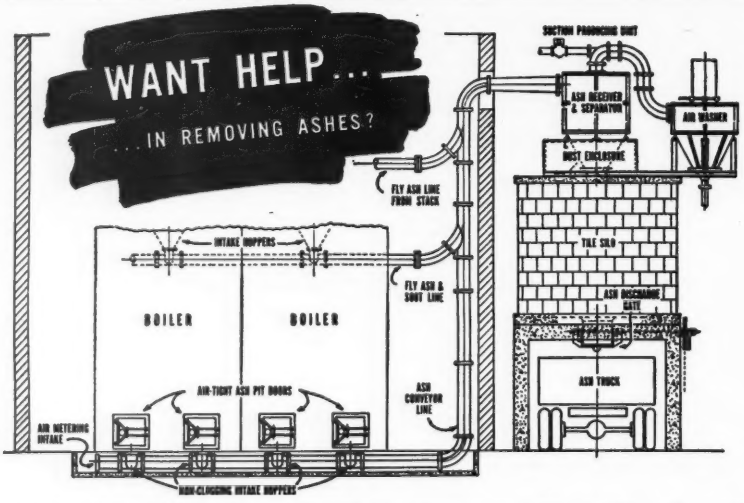

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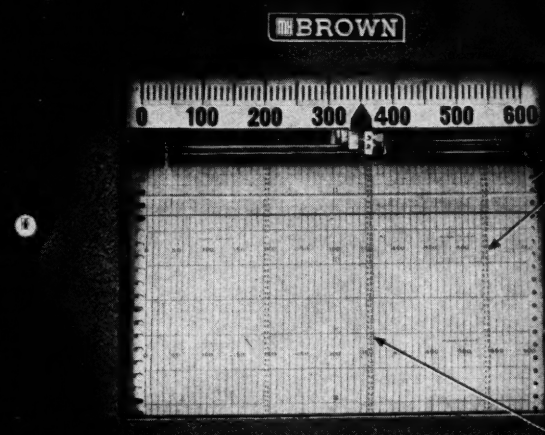

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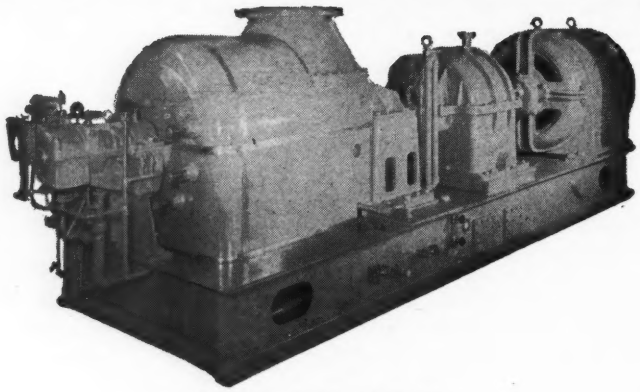

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STATEMENT of the ownership, management, circulation, etc., required by the acts of Congress of August 24, 1912, and March 3, 1933, of POWER PLANT ENGINEERING, published monthly at Chicago, Illinois, for October 1, 1946.

State of Illinois, } ss.
County of Cook, }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Kingsley L. Rice, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the POWER PLANT ENGINEERING and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

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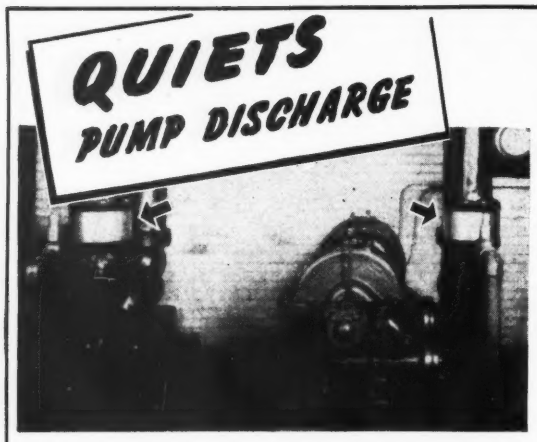

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Note these important money-saving features: 1. Spring-Loaded—when flow ceases, valve is closed without chance of water hammer; 2. Area through valve is 20% in excess of pipe area; 3. Really silent in operation; 4. All valve wear is on easily replaced or repaired parts; 5. Works equally well on Boiler Feed Lines, House Pumps, Liquid and Steam Lines; also used on Foot Valves.

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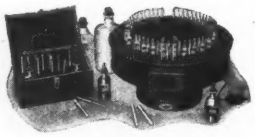

A permanent laboratory installation for making pH determinations over an extended pH range under uniform lighting conditions. Equipped with an illuminated dalite field it is highly recommended for research and central laboratory control work. Range—any three sets of LaMotte pH standards in intervals of 0.2 pH. Accurate to 0.1 pH. Price complete, $75.00 f.o.b. Towson, Md.

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4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is ..... (This information is required from daily publications only.)

KINGSLEY L. RICE,
Business Manager,

Sworn to and subscribed before me this 25th day of September, 1946.

EUNICE B. LE GASSIQUE,
(My commission expires February 19, 1948.)

New ENGINEERING BOOKS

Inspection Handbook for Manual Metal-Arc Welding, by American Welding Society's Advisory Committee. Copyright 1945; 156 pages; 6 x 9 in.; stiff paper binding; published by the American Welding Society, 33 West 39th Street, New York 18, N. Y. Price $1.50.

The preparation of this book was undertaken to aid the inspector in the performance of his duties and serve as a reliable source of basic information on the factors with which he is apt to have most difficulty. In the interest of compactness, the information has been confined to basic fundamentals and does not presume to give a complete knowledge of the subject covered. While the book is intended to be an instructive reference, it is emphasized that the codes or specifications applicable to a particular weldment always take precedence over the material contained herein should there be any conflict of information. The section headings are as follows: Application and Scope; Requirements for a Welding Inspector; Duties of a Welding Inspector; Definitions of Welding Terms and Master Chart of Welding Processes; Symbols; Manual Arc-Welding Procedure Specifications; Qualification of Welding Procedures; Qualification of Welding Operators; Heat-Treating Operations; Weldment Defects; Methods of Test for Welds and Welded Joints; and Inspection Methods.

Progress in the art of arc-welding was held back for many years due to the inability to inspect the work after it was performed with such reliability that it could be depended upon for all kinds of structure. It

A powerful, streamlined motor drives the Lagonda cleaner, with its whirling cutter head, through the toughest scale and around difficult tube turns. It's a "scale-killer" under any scale conditions, on all tubes—straight or curved.

A special lubrication system provides a continuous flow of oil to all necessary parts of air-driven motors, including the front bearing, so that longer life and trouble-free operation are assured. Water-driven motors are water lubricated. Rugged, heat-treated crown cutters chew up every bit of scale on the first bite. And "trackless" cutter teeth are spaced unevenly so as to avoid striking the same point as they revolve inside the tube.

Get all the facts about Lagonda 1300 and 2000 series cleaners for boiler tubes now. Illustrated bulletins available on request.

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TUBE CLEANERS

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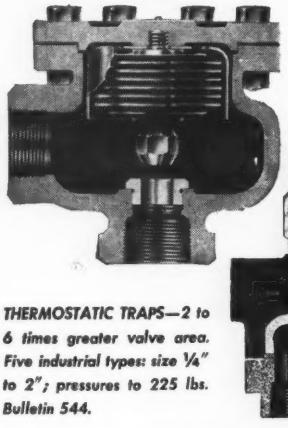

CYLINDER CONTROL VALVES—Two, three, four-way, multi-port, metering, distributing and special types. For air, steam, oil, gas, tar or water. Also lever, foot, solenoid and motor-operated types. Pressures to 5000 lbs. Catalog 546.

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IMO pumps can be furnished for almost any capacity and pressure required for pumping oil, hydraulic control fluids and other liquids over a wide viscosity range.

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was only after non-destructive methods of inspection had been devised that engineering organizations permitted the use of arc-welding in the construction of pressure vessels and other structures of equal importance. This manual handles the entire subject of inspection in a way that is not only convenient to the artisan but is highly instructive to those wishing to advance their knowledge of the subject further.

Standard Code for Welding. A 1946 edition of the Standard Code for Arc and Gas Welding in Building Construction has just been published to replace the 1941 (tentative) edition. The new edition embodies revisions based on experience in the recent applications of welding to structural fabrication and on further research investigation.

The section on design now provides for increased allowable weld unit stresses equal to those allowed for the steel being welded. Other sections on filler metal, workmanship, inspection and qualification of welding operators and procedures have also been revised.

Copies may be obtained from the American Welding Society, 33 West 39th Street, New York 18, N. Y., at 50c per copy.

Heating, Ventilating and Air Conditioning Guide, 1946, 24th Edition; 904 pages, illustrated, size 6 by 9 inches, cloth binding; American Society of Heating and Ventilating Engineers, 51 Madison Avenue, New York 10, N. Y. Price $6.00.

This annual edition of the famous guide keeps right on bringing things up to date just as its predecessors have done. It contains an enlarged technical data section and a new grouping of subjects to provide a more logical progression from fundamental principles to special applications. This order is as follows: Section 1—Principles; Section 2—Human Reaction to Atmospheric Environment; Section 3—Heating and Cooling Loads; Section 4—Combustion and Consumption of Fuels; Section 5—Heating Systems and Equipment; Section 6—Air Conditioning; Section 7—Special Applications; Section 8—Installation and Testing Codes. There is, of course, the usual catalog data section and roll of membership.

Chapter I on Terminology has been revised in conformity with the terms of basic science. Also, in the section on Principles, the new information on properties of moist air and water obtained from the co-operative ASH&VE—Towne research are incorporated in the chapter under Thermodynamics, with a new Mollier diagram in larger size than the older one for readability. The chapters on Fluid Flow, Air Contaminants, Cooling Load have been improved and revised and a new section on furnaces has been included in Chapter 18. Pipe Capacity Tables have been expanded to show them in both EDR and pounds. Chapter 44 Owning and Operating Costs shows the method of determining the actual cost of air conditioning to the owner. The Chapter on Codes and Standards has been brought up to date with information from the various State Departments concerned.

TURBINE LUBRICATION

Turbine Oil gives 34 SERVICE HOURS per Gallon over 6 YEAR PERIOD

Extent of conditioning has been to run oil through centrifuge at only 3 intervals during entire time

Lubrication Engineer's Report

"The service record of the 25,000 KW Unit in The Empire District Electric Company's Steam Turbine plant located at Riverton, Kansas, covers a six year period — beginning April, 1939.

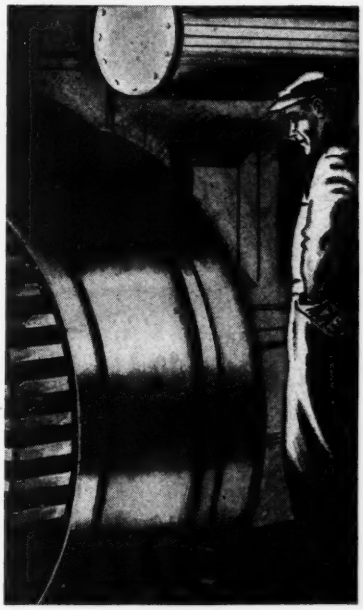
"During this time the *same* oil has been in use and 'make-up' has totaled 1,431 gallons, or an average of 34 service hours per gallon of make-up. Quantity of oil in the oiling system is 1,100 gallons. Neutralization number on oil at start of this run was .05 mg. KOH; maximum value reached was .320 mg. KOH; the average value was .208 mg. KOH; and present value .250 mg. KOH.

"There has been no draw-off of oil to add "sweetening." The make-up added has been to compensate for losses due to vaporization, leakage and such losses as occur during routine machine inspections.

"The extent of the conditioning this oil received has been to run it through a centrifuge at three intervals in the six years to remove any accumulated moisture resulting from condensation in the reservoir.

Moisture Content Negligible

"One of the reasons for the successful performance of the Cities Service turbine oil is the method used to vent the system of vapors. The hot oil return from the bearings to the reservoir, empties into a chamber carrying the screens to remove foreign particles that might damage the oil circulating pumps. A considerable vapor is liberated at this point (oil temperature, 150-160 deg. F.), and instead of being permitted to condense is drawn off through a vent line, under a slight vacuum. While there is a tangible loss of oil in the

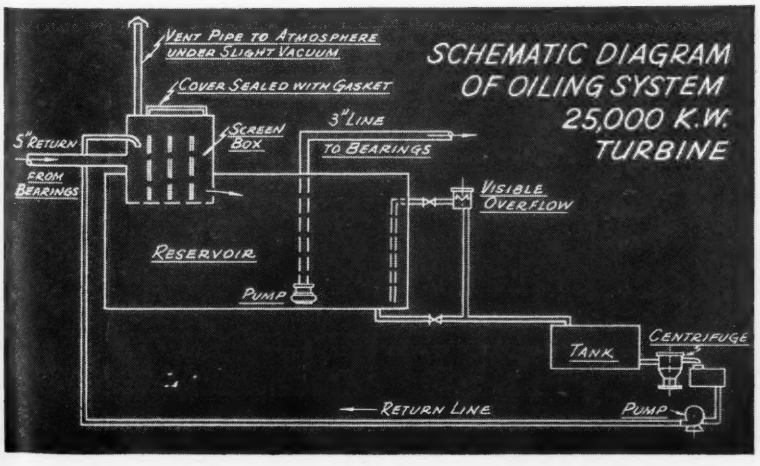


vapor, the moisture content is held practically negligible and is, therefore, of material help in maintaining the oil in good condition.

"The above is typical of the experience with Cities Service turbine oil in each of Empire's five turbo-generator units."

Expert Counsel Available

Cities Service Lubrication Engineers know ways and means for reducing costs and improving the performance of lubricants. For help or information call the branch office nearest you, or write Cities Service Oil Co., 60 Wall Tower, New York 5, N. Y.



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FOR EVERY LUBRICATION PROBLEM

CALL Cities Service FIRST!

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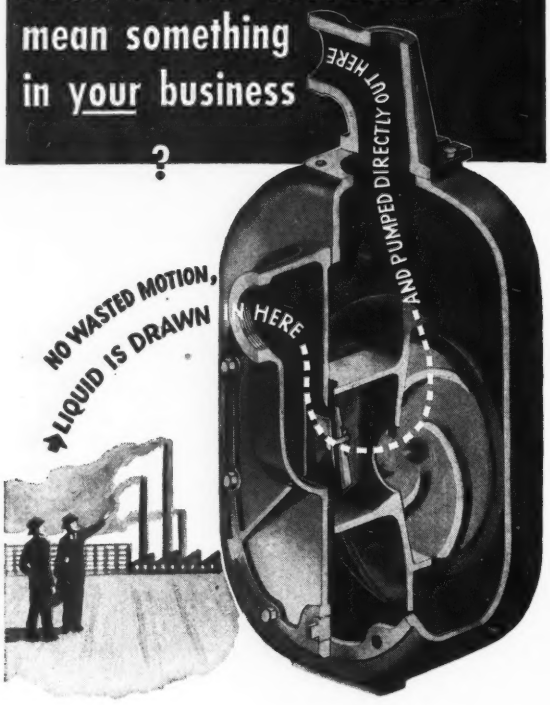

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Positively self-priming on suction lifts as high as 25 feet, a Marlow combines centrifugal efficiency with automatic action. With the exclusive Marlow diffuser method of self-priming there is no recirculation or wasted motion; a Marlow has no ports, by-passes or other auxiliary priming devices that reduce pumping efficiency. Easy and economical to operate and maintain, a Marlow has staying power, too, that you can rely on.

1. Self-primes entirely automatically; gravity flow to pump is not necessary.
2. Impeller alone moves the liquid.
3. Pumps wide variety of liquids, clear, gritty, heavy, volatile.
4. Requires practically no operating attention. Has no parts which require adjustment or manipulation.
5. Reliable for continuous or intermittent service; primes itself whenever necessary.
6. Strong, long life construction with the stamina to last far beyond ordinary service requirements.
7. 1½ to 10-inch sizes. 50 to 4000 gallons per minute.

Ask for Complete Interesting Information.

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Manufacturers of Quality Pumps since 1924.

POWER PLANT *Construction News*

Ala., Andalusia—Alabama Electric Cooperative, Andalusia, plans three new generating stations, including a steam-electric power plant in vicinity of Gantt, with initial capacity of about 25,000-kw; station at Troy, using Diesel engine-generator units, with rating of about 2500-kw; and a hydro-electric station on Conecum River, near Andalusia, with hydraulic turbine and generator for capacity of 1000-kw. Fund of $3,350,000 has been arranged through Federal aid for project, including transmission line extensions.

Calif., Jackson—Pacific Gas & Electric Co., 245 Market St., San Francisco, Calif., is projecting plans for three new hydroelectric generating stations on North Fork of Mokelumne River, vicinity of Jackson. A new plant will be built to replace present Electra station at that place, to be equipped for a capacity of 132,078-hp, with cost estimated about $15,930,000. Another station will be constructed at West End, with hydraulic turbines and electric generators for rating of 20,107-hp, estimated to cost about $4,000,000. These two plants are scheduled for completion in 1948, when work will begin on a third station, to be equipped for a capacity of 44,236, to cost over $8,000,000. Application for permission has been made to Federal Power Commission.

Calif., Richmond—Eastman Tag & Label Co., 548 Fourth St., San Francisco, Calif., tags, labels and kindred paper products, plans new plant on 10-acre tract of land on Giant Hy., Richmond, recently acquired. It will comprise a main one-story unit, about 300 x 500 ft, and several auxiliary structures. Electric power equipment will be installed. A boiler house is planned. Cost reported close to $500,000, with machinery. Hutchason & Associates, Architects' Bldg., Los Angeles, Calif., architects and engineers.

Conn., Middletown—State Dept. of Institutions, State Capitol, Hartford, Conn., has preliminary plans for new boiler plant at Long Lane Farm for girls, Long Lane, near Middletown. Cost reported about $170,000, with boilers and auxiliary equipment.

Fla., Lakeland—Light and Water Dept., City Hall, plans expansion and improvements in municipal steam-electric power plant, with installation of new turbine-generator, boiler and auxiliary equipment for increased capacity. Also will make extensions in distribution system. Cost estimated about $900,000. Financing in part has been arranged through Federal aid.

Fla., Miami—Florida Power & Light Co., 25 South Second St., has plans maturing for extensions in generating station, with installation of equipment for increased capacity. Cost reported close to $540,000. Ebasco Services, Inc., 2 Rector St., New York, N. Y., is consulting engineer.

Ill., Chicago—Globe Roofing Products Co., 2211 Schrage Ave., Whiting, Ind., prepared roofing products, plans installation of electric power equipment in new one-story felt mill at 2648 East 126th St., Chicago, about 75 x 400 ft. Cost reported over $180,000, with machinery. Work scheduled to proceed at once. E. L. Fiesenheiser, 9512 South Lowe Ave., Chicago, is engineer.

Iowa, Waverly—Electric Light Dept., 121 First St., N.E., plans extensions in municipal power plant, including installation of new 1200-kw generating unit and auxiliary equipment. Details and estimates of cost are being determined. Stanley Engineering Co., Muscatine, Iowa, is consulting engineer.

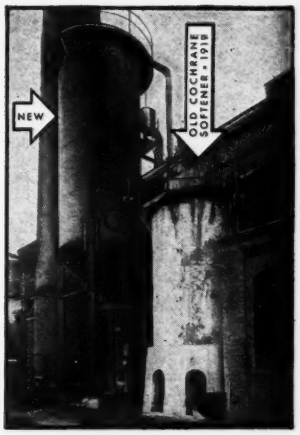
Kan., Sublette—Northern Natural Gas Co., Aquilla Court, Omaha, Neb., plans extensions in compressor stations for increased booster service for natural gas transmission lines at Sublette; Oakland, Iowa; Ogden, Iowa; Hooper, Neb.; and South Sioux City, Neb., with installation of compressor units and auxiliary equipment. Cost about $725,000. Federal Power Commission has approved project and work will begin soon. M. C. Madsen is chief engineer.

Mass., Cambridge—Cambridge Electric Light Co., 384 Western Ave., Steam Division, plans new steam-generating station, with high-pressure boilers and auxiliary equipment for large capacity. Cost reported over $2,500,000. Gilbert Associates, Inc., 412 Washington St., Reading, Pa., is consulting engineer.

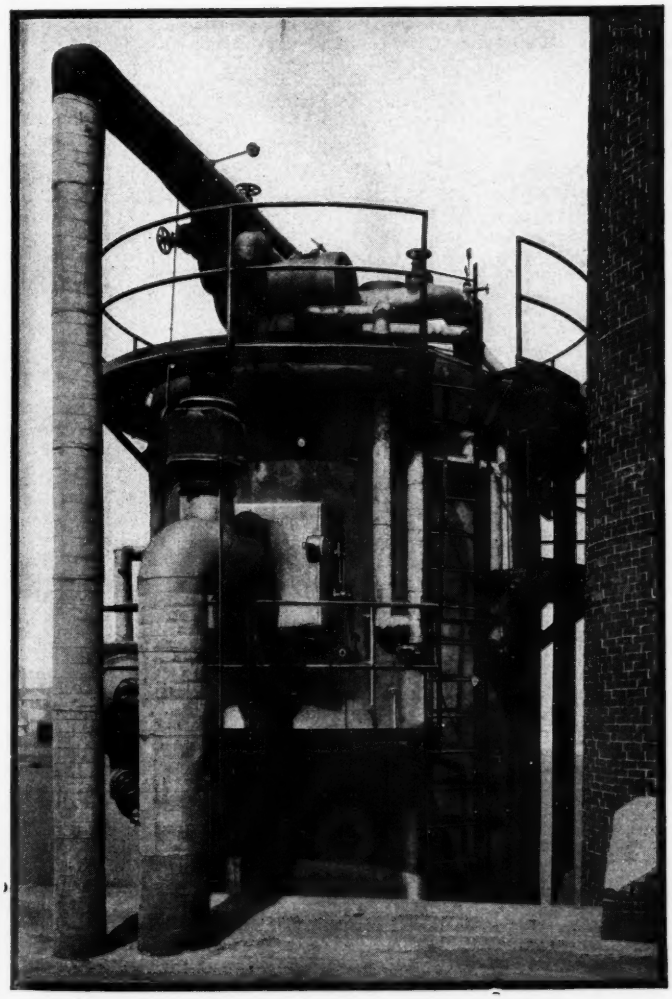
Mich., Menominee—Lloyd Mfg. Co., furniture, plans new power plant for service at factory on State St. Details and estimates of cost will be determined at early date.

Above: Cochrane Flow Meter Panel for Automatic Control of Chemical Feed.

HISTORY (and Cochrane Water Conditioning Equipment) REPEATS



COCHRANE Water Conditioning Equipment does its work so thoroughly, so efficiently and with so little extra upkeep costs that "repeat" orders are the rule rather than the exception. The Deaerating Hot Process Softener shown in these photographs was ordered to replace the old Cochrane Hot Process Softener shown alongside it. This older piece of equipment is still functioning, but was not able to handle the increased load. At last reports it was destined to be shifted to another job. Write for details of this installation and facts about Cochrane Hot Process Water Softeners. Cochrane Corporation 3123 N. 17th St., Philadelphia 32, Pa.



Left: Upper part of Softener showing Deaerator Mechanism and Cochrane Multiport Relief Valve.

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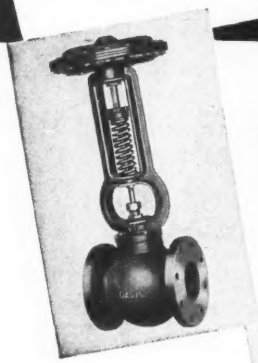
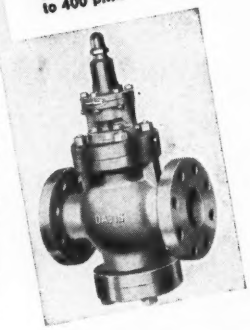
- For Reduced Pressures up to 500 p.s.i.
- Sizes to 24"
- For Oil, Water, Gas, Steam
- Either Spring or Weight Loaded

DAVIS PRESSURE REGULATORS



Left: Davis No. 14 direct connected spring loaded regulator for steam, air, gas, water, oil. For pressures to 400 p.s.i. For reduced pressures 0 to 200 lbs.

Below: Davis No. 40 regulator for heavy duty, variable load conditions. Unaffected by high pressure fluctuations. Self-contained, pilot operated. For pressures to 400 p.s.i.



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Davis *double seated balanced disc* regulators for continuous flow conditions.

Piston type, counterweighted, for pressures of 150 lbs. and less.

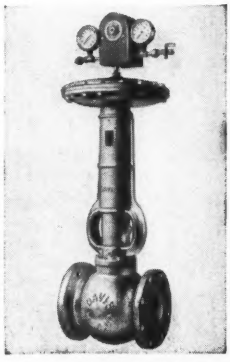
The *diaphragm type* for low service pressures.

For dead end service, a *single seated type* maintains pressure reduction irrespective of flow.

Davis *integral auxiliary pilot* controlled regulators for heavy duty, variable load service for either dead end or continuous flow.

Davis separate auxiliary control type has positive control of disc action, and gives dependable, accurate regulation under variable conditions.

Bulletin 100A and easy-to-use selection charts make pressure regulator selection easy. Send for literature today.



Davis No. 401 regulator. A compact instrument type for accurate, sensitive pressure control. Sizes ½" to 10".

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DAVIS VALVES

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Mich., Muskegon—Consumers Power Co., Jackson, Mich., has plans in progress for new generating station in vicinity of Muskegon, with turbine-generators, high-pressure boilers and auxiliary equipment for large capacity. Cost reported close to $3,500,000. Project will include extensions in transmission lines for connection with present system.

Mich., Petoskey—Electric Light Dept., 453 East Lake St., plans new steam-electric power plant, with capacity of about 3000-kw, to supplement present municipal hydroelectric station. Installation will include two 1500-kw generating units, boilers and accessories. Cost reported close to $470,000.

Miss., Jackson—Mississippi Power & Light Co., Jackson, will have plans prepared by Ebasco Services, Inc., 2 Rector St., New York, N. Y., consulting engineer, for proposed new generating station on site near city limits, recently referred to in these columns. Installation will include a 30,000-kw turbine-generator unit, high-pressure boiler and auxiliaries. Cost estimated about $4,500,000, with transmission lines.

Mo., Kansas City—Kansas City Power & Light Co., 1330 Baltimore Ave., plans extensions in steam division at generating station, including installation of new high-pressure boiler, rating about 375,000 lb steam per hour, and auxiliary equipment. Work will be carried out soon. Cost reported over $300,000.

N. Y., Buffalo—Buffalo Niagara Electric Corp., Electric Bldg., plans expansion in local Charles A. Huntley steam-electric generating station, including new multi-story addition and installation of an 80,000-kw turbine-generator, high-pressure boiler and auxiliary equipment. Work is scheduled to begin in 1947, with completion in following year. Cost estimated about $9,000,000, including transmission line extensions.

N. Y., New Platz—State Dept. of Public Works, State Office Bldg., Albany, N. Y., plans new boiler plant for central-heating service at State Teachers' College, New Platz. Cost reported about $210,000, with boilers and accessories.

Ohio, Marietta—Monongahela Power Co., Watson Bldg., Fairmont, W. Va., plans new steam-electric generating plant in vicinity of Marietta, to be equipped with turbine-generators of 150,000-kw gross capacity, high-pressure boilers and auxiliaries. Extensions will be made in transmission lines for connection with present high-tension system. Cost estimated about $11,000,000. Proposed to begin work soon.

R. I., Providence—Narragansett Electric Co., 51 Westminster St., has authorized further expansion in steam-electric generating station on Manchester St., where extensions are now in progress, including addition to building, installation of turbine-generator, boiler and accessories, to cost approximately $4,500,000. New work to follow on completion will comprise another generator unit installation, boiler, coal unloading facilities, conveyor system and miscellaneous work. Latter program is scheduled for completion in about 36 months.

Texas, Temple—Brazos River Transmission Electric Cooperative, Inc., Waco, Texas, is considering preliminary plans for new hydroelectric generating station on Leon River, near Temple. Cost reported close to $2,000,000. Company arranged financing through Federal aid several months ago for two hydroelectric power plants, and it is understood that proposed station noted is part of that program.

Utah, Devil's Slide—Ideal Cement Co., Denver National Bank Bldg., Denver, Colo., plans installation of electric power equipment in connection with extensions in mill at Devil's Slide, including number of new buildings and installation of machinery for increased capacity. Cost about $2,500,000.

Wash., Mount Vernon—Washington Cooperative Farmers' Association, Mount Vernon, poultry, etc., plans new one-story processing plant, 120 x 210 ft. Electric power equipment will be installed. A cold storage and refrigerating plant will be provided, with capacity for handling about 90,000 lb poultry daily. Cost estimated approximately $300,000. Work is scheduled to begin at once. Sigmund Ivaarson, Skinner Bldg., Seattle, Wash., is engineer.

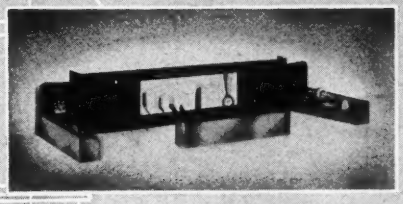
Wis., Appleton—Appleton Coated Paper Co., Inc., plans installation of new steam-generating unit at power plant for service at mill, including boiler, combustion apparatus and auxiliaries. Pfeifer & Shultz, and Jesse B. Harris Co., Wesley Temple Bldg., Minneapolis, Minn., are engineers.

Wis., Cornell—Northern States Power Co., Eau Claire, Wis., plans two new power substations in connection with proposed transmission line from Jim Falls to Cornell. Cost reported close to $70,000. Proposed to begin work soon.

Thermix Products at the

1946 POWER SHOW

GRAND CENTRAL PALACE, NEW YORK CITY



For the first time since the war, Thermix Products will be on display at the New York Power Show.

Many new developments are to be seen and you are cordially invited to drop in at booths 50 and 51.

High on the list of attractions will be a full scale working model of a Thermix Duplex Dust Collector using alternately an Aerotec tube and Aerotec electrical secondary. Heacon Dampers will control flow and a Thermix Fan Stack will furnish the draft. Sides of the equipment will be transparent for observation.

Our engineers will be on hand to welcome you and answer any inquiries.

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HUNDREDS of *NEW IDEAS*

in Heating
Ventilating
Air Conditioning

Don't miss the Heating and Ventilating Exposition if you're connected with these fields in any way. It's the first such show since 1940. Plenty has happened since. This year's show is far and away the biggest yet!

Get the vital new ideas you *need* to progress in your field—in a short visit, under one roof! See firsthand the more than 300 exhibits of all types of heating, ventilating, air conditioning and related equipment.

7th INTERNATIONAL HEATING & VENTILATING EXPOSITION

The Air Conditioning Exposition

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aims to inform the consumer and help him to buy more intelligently.

2. Good Advertising . . .

tells the truth, avoiding misstatement of facts as well as possible deception through implication or omission. It makes no claims which cannot be met in full and without further qualification. It uses only testimonials of competent witnesses.

3. Good Advertising . . .

conforms to the generally accepted standards of good taste. It seeks public acceptance on the basis of the merits of the product or service advertised rather than by the disparagement of competing goods. It tries to avoid practices that are offensive or annoying.

4. Good Advertising . . .

recognizes both its economic responsibility to help reduce distribution costs and its social responsibility in serving the public interest.

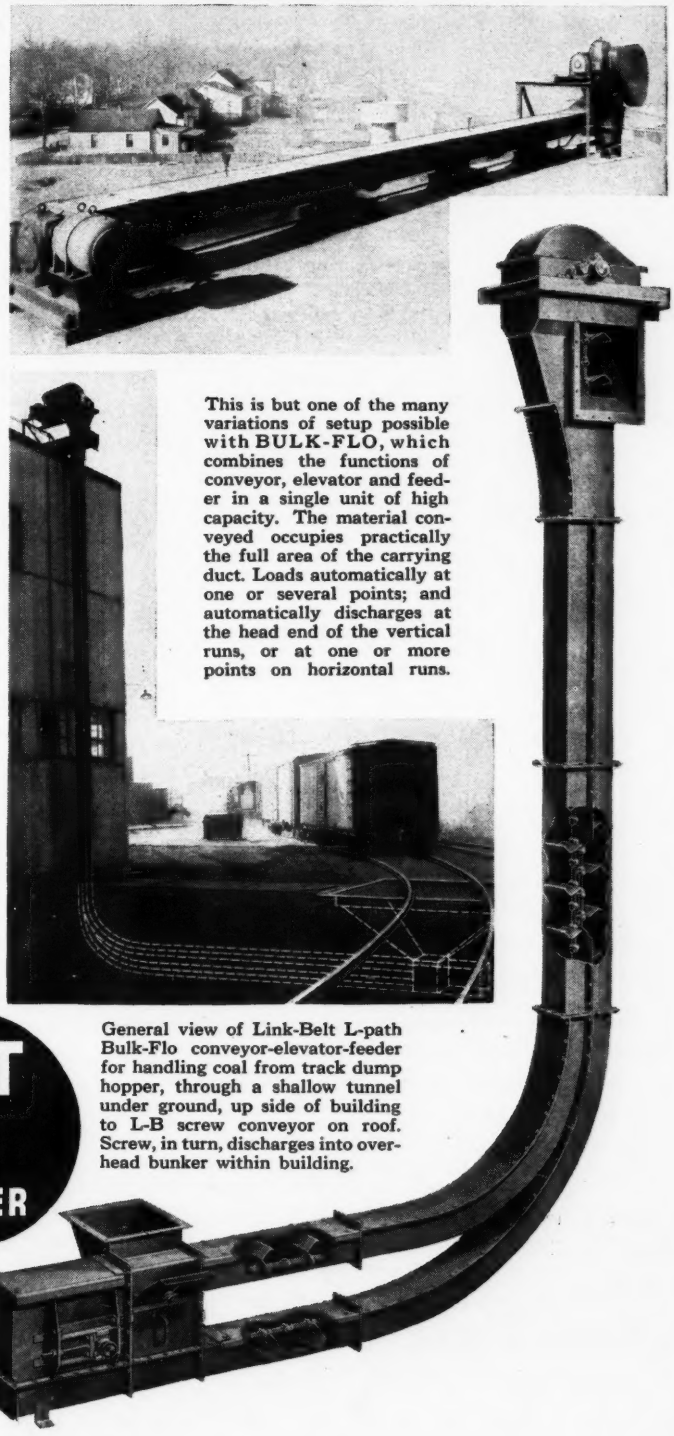
Advertising Federation of America

Power Plant ENGINEERING

Bulk-Flo Handles Coal Economically from Car to Storage Bin at Starch Plant

• The problem of the Union Starch & Refining Company, Granite City, Illinois, was to handle coal without manual labor from hopper bottom cars — horizontally 30′, then vertically 50′, then to an overhead bin feeding an automatic stoker on a dryer for reducing moisture content of gluten feed.

The answer was a Link-Belt BULK-FLO unit, discharging to a screw conveyor with multiple discharge points. In addition to cutting handling cost and saving manual labor, this setup is self-feeding from bottom of track hopper . . . is compact and fully enclosed . . . has underground horizontal run . . . eliminates auxiliary construction . . . is equipped with automatic limit switches. Link-Belt is prepared to help you solve similar problems.



This is but one of the many variations of setup possible with BULK-FLO, which combines the functions of conveyor, elevator and feeder in a single unit of high capacity. The material conveyed occupies practically the full area of the carrying duct. Loads automatically at one or several points; and automatically discharges at the head end of the vertical runs, or at one or more points on horizontal runs.

10,415

LINK-BELT

Bulk-Flo

ELEVATOR-CONVEYOR-FEEDER

General view of Link-Belt L-path Bulk-Flo conveyor-elevator-feeder for handling coal from track dump hopper, through a shallow tunnel under ground, up side of building to L-B screw conveyor on roof. Screw, in turn, discharges into overhead bunker within building.

LINK-BELT COMPANY

Chicago 8, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

VALUE PLUS!

Your money's worth . . . and more. That's a good thing to keep in mind when buying flanges . . . and it's what you get when you specify Phoenix Flanges. They're drop-forged . . . with all the toughness and stamina it takes for long service, safety, and downright dependability.

They're made from a mild steel that is especially suited to welding and machining and every one complies with ASA requirements and ASME and ASTM specifications. Furthermore, they're available in a wide range of styles and sizes to meet your requirements.

If you haven't already received your copy of the Phoenix Flange Catalog, write for it today . . . no charge.

Flange Division of
PHOENIX MANUFACTURING COMPANY
CATASAUQUA, PA. △ JOLIET, ILLINOIS

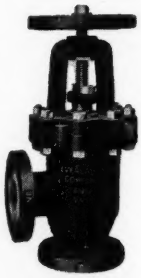
Get safe DUAL-VALVE BLOW-OFF CONTROL

Install an Everlasting Duplex Blow-Off Unit and you will be SURE of completely dependable valve teamwork. Quick opening and closing supplied by the "regular" model W Everlasting lever-operated Valve . . . security completed by the wheel-operated Everlasting Companion Valve.

The Everlasting Valve opens with an easy 70-degree movement of the operating wrench; provides unimpeded straight-through flow; closes with the same ease and sureness. Each opening or closing action regrinds the disc, keeping it tight-fitting.

The sealing valve

The Everlasting Companion Angle Valve bears the brunt of the blow-off force and supplies necessary resistance to the wearing action of the boiler water.


The blowing valve

The Everlasting Duplex unit meets all code requirements for boiler-blow-off service. Either valve may be obtained separately.

Write for Everlasting Bulletin E-100 giving full information.

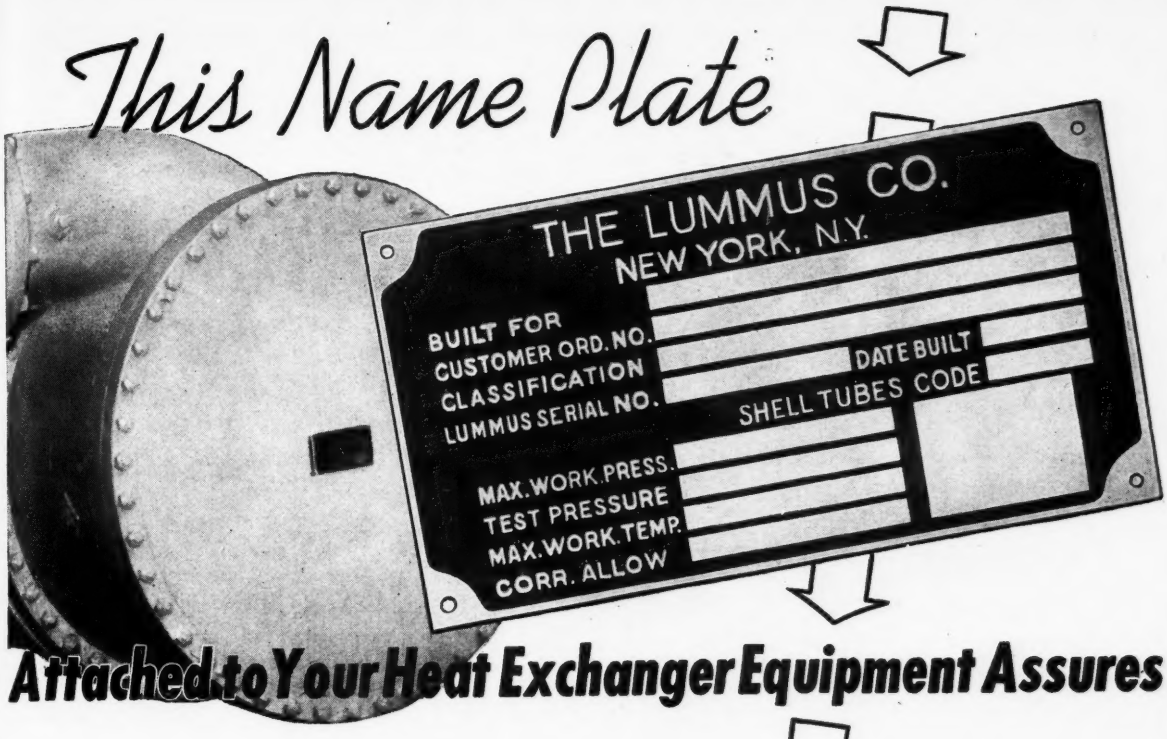
EVERLASTING VALVE CO., 49 FISK ST., JERSEY CITY 5, N. J.

EV-275

Everlasting Valves

for everlasting protection

This Name Plate



Attached to Your Heat Exchanger Equipment Assures

CHECK your next installation on all these important points to see if it measures up to the guarantee behind the Lummus name plate. Lummus heat exchangers are supplied in all pressure ranges employed in modern power plants, refineries and other industries. Each unit is especially designed and manufactured for the particular service for which it is intended.

Lummus engineering service is always available for the study of specific heat exchanger problems. For further information write to: The Lummus Company, 420 Lexington Avenue, New York 17, N. Y.

- Sound design
- Rugged construction
- Uniform operation
- Dependable service
- Long life
- Ease of maintenance
- Standardized parts — simplify replacements
- Full efficiency guaranteed
- Extensive servicing facilities
- Class A workmanship

THE LUMMUS COMPANY

420 LEXINGTON AVENUE, NEW YORK 17, N. Y.

600 So. Michigan Ave., Chicago 5, Ill. · Mellie Esperson Bldg., Houston 2, Texas
634 So. Spring St., Los Angeles 14, Calif. 78 Mount St., London, W.1, England

Lummus

HEAT EXCHANGER DIVISION

cut maintenance costs with AIRETOOL tube cleaners

The simplicity of construction in all Airetool Tube Cleaners assures lower maintenance costs . . . and cleaner tubes in power plants. All vital wearing parts in Airetool Cleaners are easily replaceable on the job.

Airetool's New Form cutters eliminate tracking and give tubes a clean, smooth, undamaged surface. Airetool's motors, with Balanced Rotor and Power Seal, deliver more power—they make hard jobs easy. The motors are air and steam or water driven.

There's an Airetool Cleaner for every type of water tube and fire tube boiler, condenser, heat exchanger, and all other tubular construction—straight or curved—in sizes from ¼" to 24" I. D.

Illustrated is the forwardly swing arm head with universal joint mounted on a "4000" series motor, air or steam driven. It is designed for bent tubes from 1¾" to 12" I. D.

AIRETOOL expanders

Airetool manufactures a complete line of tube expanders—meeting every requirement of the modern power plant. Special heat-treated alloy steels assure a uniform grain and hardness.

AIRETOOL
MANUFACTURING COMPANY
SPRINGFIELD, OHIO

Write Dept. PV for bulletins on tube cleaners and tube expanders especially designed for use in power plants.

PIPE JOINT COMPOUND IN STICK FORM

FOR ALL THOSE PIPE INSTALLATION AND REPAIR JOBS. ALWAYS READY FOR INSTANT USE.

HANDY — CLEAN — ECONOMICAL

Now — Fully accepted and endorsed by plumbers and maintenance men the country over.

Write for Free Sample

NO LEAKS! Just rub 3 or more strokes across pipe threads. It spreads and fills threads when turned.

Note these FEATURES

★ Withstands gasoline, oil, butane, propane, Freon, air, water, steam, acid, gas, brine, refrigerants.

★ Lubricates and completely seals pipe joint threads, nuts, bolts, gaskets, turn-buckles, etc.

★ Contains no lead. Contains no injurious ingredients.

TRY IT! TEST IT! YOU'LL USE IT!

Lake Chemical Company

640 N. WESTERN AVE., CHICAGO 12, ILLINOIS

COPR. 1946

MANUFACTURERS OF DEPENDABLE AUTOMATIC CONTROLS FOR A QUARTER OF A CENTURY

MERCOID

AUTOMATIC CONTROLS FOR HEATING, AIR CONDITIONING REFRIGERATION AND VARIOUS INDUSTRIAL APPLICATIONS

EQUIPPED EXCLUSIVELY WITH HERMETICALLY SEALED MERCURY SWITCHES ASSURING BETTER CONTROL PERFORMANCE AND LONGER CONTROL LIFE

THE MERCOID CORPORATION · 4223 BELMONT AVENUE · CHICAGO 41, ILLINOIS

There's a Brighter Spot in Your Coal Picture

with

AMERICAN RING CRUSHERS

More Efficient Coal Preparation

Because of diminished production, coal piles may not be normal for some time to come. To help offset this condition proper reduction of coal to uniform sizes is important. Control of fines and no oversize makes each ton go farther. The uniform reduction of American Rolling Ring Crushers reduces the waste of unwanted fines and eliminates oversize.

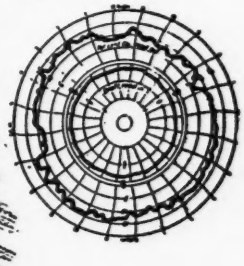
Greater Combustion Efficiency . . .

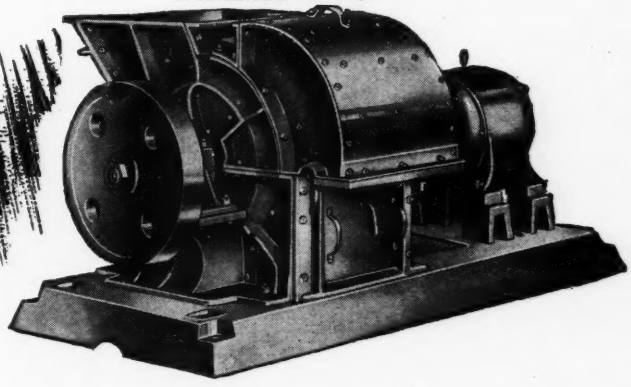
For the greatest possible BTU yield per pound of coal from available grades in your field . . . uniform reduction is essential. All grades of coal are reduced to a uniform product from ROM or lump by American Rolling Ring Crushers. The uniformly crushed product results in reduced CO_2 loss from excess air and reduced ash pit loss.

Low Cost Operation . . .

With the uptrend in fuel prices and operating costs, the extremely low operating cost of Americans effects savings that help offset other cost increases. The total operating cost of Americans is less than 1c per ton.

Graphically illustrating increased ash pit loss and low combustion efficiency resulting from improperly prepared coal, the CO_2 chart below emphasizes the need for proper coal sizing such as Americans give.





Only Americans have the patented Manganese Shredder Rings that split coal instead of crushing it. Each ring has 20 cutting edges and is free to swing by centrifugal force. It deflects upon contact with tramp metal and eliminates the need for shear pins and other conventional safety devices.

The American Rolling Ring Type "S" Crusher, shown above, has set a high standard for efficient fuel sizing and crushing. Dependable, economical service is a certainty with an American. Low power demand, minimum maintenance and a high rate of operating efficiency are factors that assure lowest operating cost. Custom-built, there's an American to fit your specific job requirements.

Write for Bulletin "Crushing Coal at Less Than One Cent a Ton"

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1429 Macklind Avenue
St. Louis 10, Mo.

ONLY 1 REASON

for PACKINGS

ENGINEERS know that all leakage must be prevented whenever possible . . . it absolutely must be kept under control in all instances. That's why packings are needed!

Even if your service conditions are unusually severe with oil, asphalt, acid or any other fluid to contend with, Quaker has a brand to meet it.

Our packing experts are ready at all times to suggest and recommend the proper packings that will give you maximum results.

Specify Quaker Packings. Buy from your local Mill Supply House or Hardware Dealer.

REG. U.S. PAT. OFF.

QUAKER ROD PACKINGS

A Complete Line of

Rubber
Duck and Rubber
Flax
Hydraulic
Asbestos
Metallic
Semi-Metallic

for all types of Service Conditions

QUAKER SHEET PACKINGS

Rubber
Asbestos
Fibre

For all service applications

QUAKER RUBBER CORPORATION

Mfrs. Industrial Rubber Products

PHILADELPHIA 24, PENNSYLVANIA

NEW YORK • CHICAGO • CLEVELAND • HOUSTON

Western Territory

Quaker Pacific Rubber Company

San Francisco • Los Angeles

HOW MAGIC BOILER PRESERVATIVE

Guards 2 Ways Against Corrosion

Corrosion occurs when oxygen or acid gases act on metal. Oxygen and carbonic acid gas are found dissolved in all natural waters to a varying degree. Hydrochloric acid gas is formed under steaming conditions, when chlorides of iron, magnesium, calcium or sodium are present in feedwater. The liberation of hydrochloric acid gas from these substances is accelerated by the presence of sulfates of calcium and magnesium. Carbonic acid gas is liberated from bicarbonates of calcium and magnesium.

MAGIC Boiler Preservative acts in two ways to guard against corrosion. First, the MAGIC dissolved in the boiler water "binds" acid gases and represses their liberation. Second, the MAGIC film of protection keeps corroding substances from contact with the metal.

Write for Descriptive Bulletin.

GARRATT-CALLAHAN CO.

Established 1904

OF ILLINOIS
59 East Van Buren St.
Chicago 5

OF NEW YORK, Inc.
1328 Broadway
New York City 1

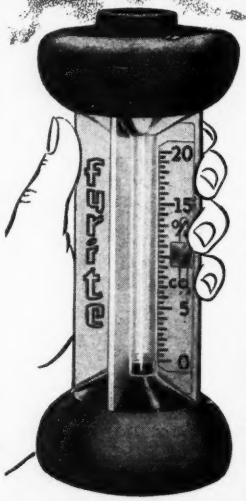
OF CALIFORNIA
148-156 Spear St.
San Francisco 5

SMOKE PREVENTION

with the...

FYRITE

CO_2 INDICATOR



The relationship of the CO_2 test to smoke prevention is very close. A boiler that smokes is a boiler that is burning fuel inefficiently. CO_2 percentage in the flue gases—easily and quickly measured with the FYRITE—is an accurate, dependable index of combustion efficiency.

Checking CO_2 content of the flue gases regularly with the FYRITE is your best assurance of continuously maintaining maximum combustion efficiency, which insures fuel economy, long furnace life and freedom from smoke nuisance. This freedom from smoke is doubly important now with smoke abatement ordinances being enacted in a rapidly growing number of localities.

There is nothing tricky or complicated about a CO_2 test with the FYRITE—requires no skill or special training—there are no valves, clamps, or leveling bottle to manipulate—one test takes less than a minute. More than 13,000 in successful use.

Send for Bulletin 703.

$24.00 Complete with rubber aspirator bulb, industrial type flue filter, and carrying case.

BACHARACH
Industrial Instrument Co.
7000 BENNETT STREET
PITTSBURGH 8, PA.

OXYGEN INDICATOR *employing FYRITE principle, for direct oxygen analysis, also available. Ask for Leaflet 700.*

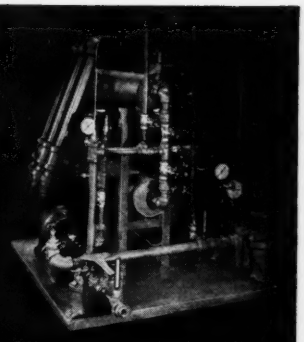
The HEAT Parade

OF PEABODY BURNERS

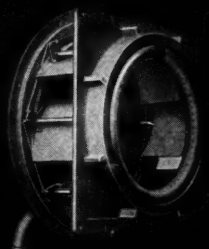
Peabody leads the heat parade of combustion equipment . . . because Peabody has led in concentration and specialization in the field of combustion engineering through the years. Peabody has the "know-how" and the advanced designs to solve your combustion problems.

If you require burners to fire oil, or gas, or pulverized coal, or any combination of these fuels call for a Peabody engineer.

Peabody engineers stand ready to help you select, from the wide variety built, the Peabody equipment that best fits your particular requirements.



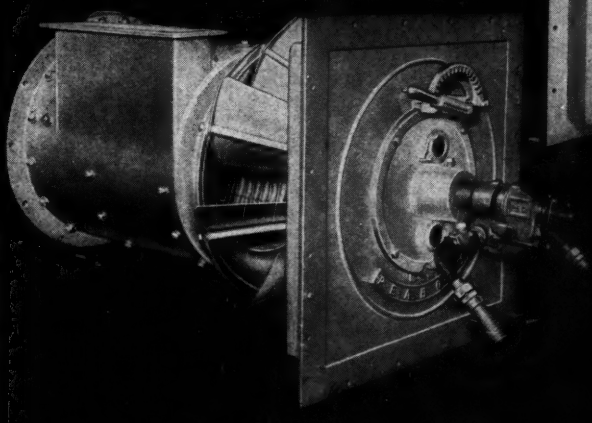
OIL PUMP AND HEATER SET



REFINERY BURNER FOR GAS AND OIL

BLAST FURNACE GAS BURNER

COMBINED COAL AND OIL BURNER



COMBINED GAS AND OIL BURNER

To turn on the heat, turn to Peabody

PEABODY ENGINEERING CORPORATION

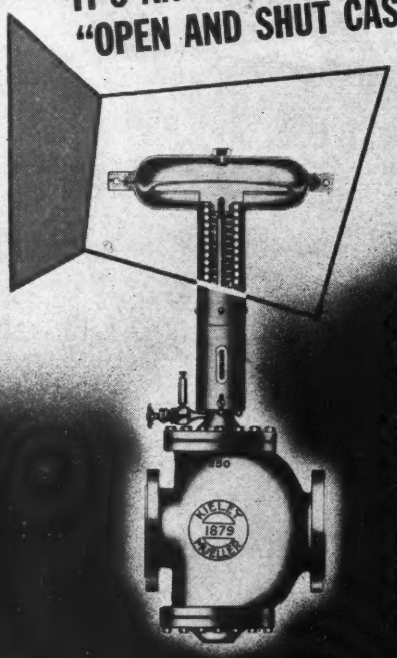
580 FIFTH AVENUE • NEW YORK

ATLANTA, BOSTON, CHICAGO, CLEVELAND, DENVER, DETROIT, EAGLE PASS, Tex., HONOLULU, HOUSTON, KANSAS CITY, LOS ANGELES, NEW ORLEANS, PHILADELPHIA, PORTLAND, Ore., ST. LOUIS, ST. PAUL, SAN FRANCISCO, SEATTLE

BUENOS AIRES • MEXICO CITY • MONTREAL

PEABODY LIMITED, LONDON

IT'S AN "OPEN AND SHUT CASE"



for K&M's *Revolutionary*

KONTROL MOTOR DIAPHRAGM VALVE

Just two simple quick-acting clamp screws to loosen, and your diaphragm casing is off. Tight-sealing clamp ring eliminates multiple bolts completely. Duo-seal molded diaphragm lips are automatically self-sealing.

67 years of control engineering "know how" produced this revolutionary new KONTROL MOTOR . . . featuring these design innovations:

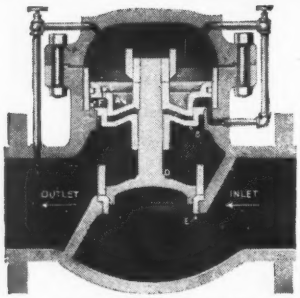
- Pressed Steel Diaphragm Casing . . . lighter . . . tougher, more durable.
- Rigid Welded Steel *Tubular* Yoke.
- Long calibrated Steel spring . . . fully enclosed.
- Enclosed ball bearing Spring Adjusting Screw.
- Streamlined Flow Valve Body with high capacity . . . unrestricted flow areas.
- Super-finished Disc Guides, *honed* guide bushings, top and bottom . . . for minimum friction; increased life.

Used with air operated instruments or auxiliary pilot units, the K & M KONTROL MOTOR regulates the flow of steam, liquids or gases — efficiently and sensitively. Send us your control problems. We'll show you how the KONTROL MOTOR valves will solve them. Write for new KONTROL MOTOR bulletin.

KONTROL KIELEY & MUELLER MOTOR

KIELEY & MUELLER, INC., North Bergen, New Jersey

Engineered PROTECTION for HIGH PRESSURE BOILER FEEDLINES



Golden Anderson HYDRAULIC Double Cushioned Check VALVES

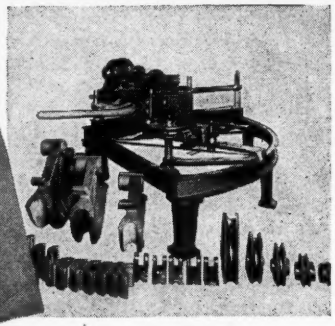
An excellent example of the outstanding engineering built in every Golden-Anderson Valve. Designed for high pressure boiler feed lines, the double cushioning feature prevents any shock or jar in sudden valve closure. Needle valve control allows close adjustment to regulate the operating speed for any operating condition. Also available with manual handwheel control, in angle or globe patterns, sizes 2½" to 14".

GA

GOLDEN-ANDERSON VALVE Specialty Company

KEENAN BUILDING • PITTSBURGH 22, PA.

BENDS PIPE EASILY AND QUICKLY INTO ALL SHAPES



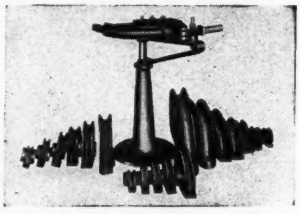
"American"

COLD PIPE, CONDUIT and TUBE BENDING MACHINES

Twelve types to select from.
Hand operated capacities ¼ to 6" inclusive. Motor operated ¾ to 8" inclusive.

A few of Our More Than 12,000 Customers:

Kaiser Shipbuilding Co.; Bethlehem-Hingham Shipyards; Portsmouth Navy Yard; Moore Drydock Co.; Stone & Webster Engineering Corp.; E. I. DuPont deNemours & Co.; West Penn Power Co.; Illinois Central Railroad; Federal Pipe & Supply Co.; Alabama Drydock Co.; Westinghouse Elec. & Mfg. Co.; Todd-Bath Shipbuilding Co.



"American" PIPE BENDING MACHINE Company INC

Write Air Mail for printed matter.

Quick Deliveries
16 FURNACE ST.
POULTNEY, VT.

Alcatraz Island on San Francisco Bay, one of the world's most famous penal institutions.
Inset, ENTERPRISE DSG-6 Diesel Engine.

ENTERPRISE SERVING JUSTICE

Installed on Alcatraz in 1938 the "Rock's" ENTERPRISE Diesel Engine generating unit provides a continuous supply of power for the entire island. When all other sources fail, this ENTERPRISE Diesel stands ready to pick up the load instantly and carry power requirements as necessary.

Battleship-shaped Alcatraz...its lights indicative of ENTERPRISE dependability...is a constant memorandum that stationary power needs—of whatever kind—can be adequately filled with ENTERPRISE Diesels. Each ENTERPRISE application is specifically engineered for the job. Parts and service at strategic locations.

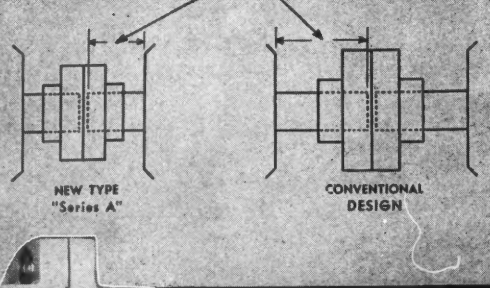
ENTERPRISE
ENGINE AND FOUNDRY CO.
18th and FLORIDA STS. SAN FRANCISCO, CALIF.
NEW YORK • BOSTON • NEW ORLEANS • CHICAGO • SEATTLE • WASHINGTON, D. C.

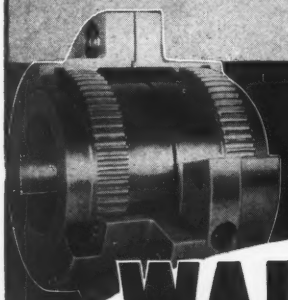
Our Sixtieth Year 1886–1946

DIESEL ENGINES • PROCESS MACHINERY • OIL BURNERS • HEAVY MACHINERY

No Wonder This New Coupling Design Has Made A Hit With Coupling Buyers

NOTICE THE IMPORTANT *Difference* IN LENGTH OF SHAFT





THEY WANT THE ADVANTAGES OF THIS NEW

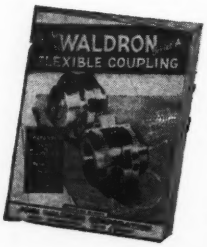
WALDRON
Gear Type Series "A" COUPLING

The new "Series A" design provides a much larger maximum bore to permit use of smaller sized couplings than would ordinarily be required. Smaller size takes up less space, needs less shaft extension—looks better—costs less.

It embodies all Waldron construction refinements. An all steel coupling that compensates for misalignment without adding stress to shaft or bearings.

Send for New Catalog

Catalog 57 contains full details and rating tables on following types; Standard, Heavy Duty, Mill Motor, Marine, Floating Shaft, Jordan, Shear Pin, Oil Collector, Cut Out. Write today.



COUPLING DIVISION

JOHN WALDRON CORP.
Main Office and Works
New Brunswick, New Jersey
COUPLINGS

LIQUIDOMETER
Tank Gauges

ALWAYS DEPENDABLE

FOR GAUGING LIQUIDS OF ALL KINDS

100% AUTOMATIC

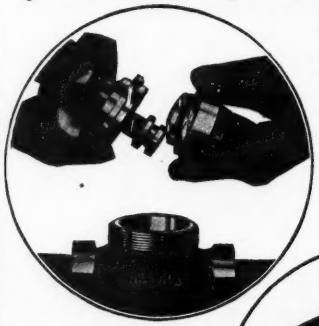
APPROVED BY UNDERWRITERS' LABORATORIES

WRITE for COMPLETE DETAILS

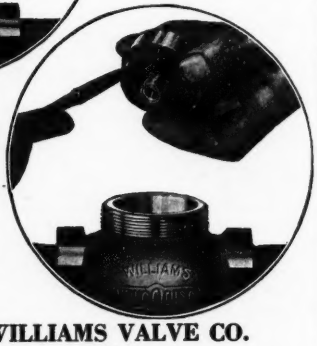
"LIQUIDS WORTH STORING ARE WORTH MEASURING"

THE LIQUIDOMETER CORP.
36-31 SKILLMAN AVE., LONG ISLAND CITY, N.Y.

Use VULCODISC
for trouble-free valve jobs



In renewing the disc, note how easily and quickly the Vulcodisc Jiffy Disc Holder slips off the stem head. Only the disc lock nut to remove and the old disc is off and replaced in a jiffy.



Dense without being brittle—tough, yet resilient, Vulcodisc will not swell, warp or soften—in fact, its absorption is less than 1 per cent. . . . That is why an old Vulcodisc comes out of the disc holder as easily as a new one goes in. No need for hammer and chisel to cut the disc out in pieces—distorting and disfiguring the holder.

THE D. T. WILLIAMS VALVE CO.
Cincinnati, Ohio

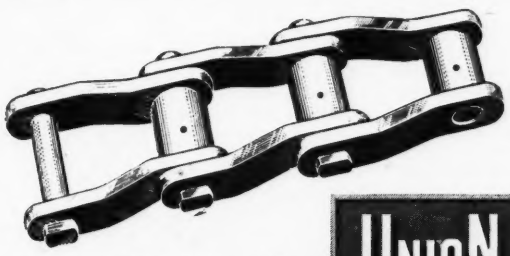
B for BUSY...

Busy doing what? Busy making honey, of course. An unmitigated specialist, the bee. Honey and honey alone is its line, and in its line it's a terrific perfectionist.

SPROCKET CHAINS...
and Sprocket Chains Alone Are Our Business

What we don't know about making honey would fill a shelf of books. What we do know about making sprocket chains would fill the same shelf. That's all we do—make sprocket chains. We're specialists—and even, we like to think, perfectionists. So it's natural that when a manufacturer has decided upon economical, efficient, trouble-free sprocket chains to solve his problems in power transmission or materials handling, he brings those problems to us at Union Chain.

The Union Chain and Manufacturing Company - Sandusky, Ohio



Union HB Offset Sidebar Roller Chain is manufactured in a complete range of strengths and in sizes from 1½" to 6" pitch. Recommended for heavy duty drives.

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Flexible Couplings
- Roller chain type
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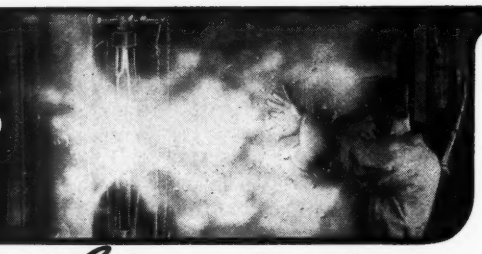
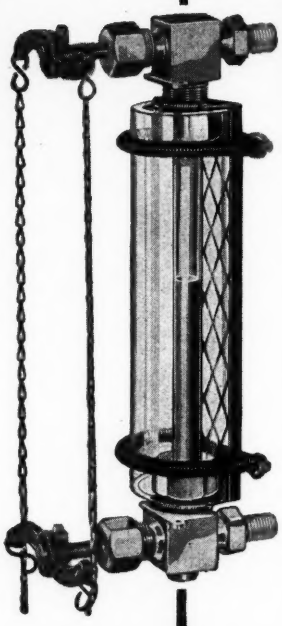


Dangerous Flying Glass is Bottled Up



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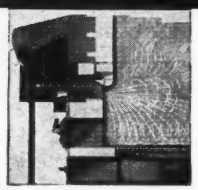

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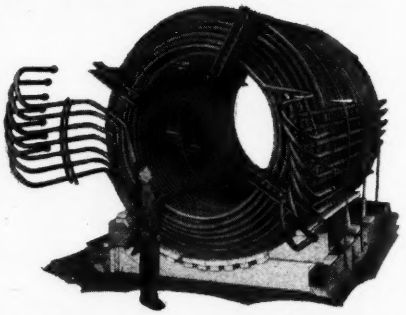

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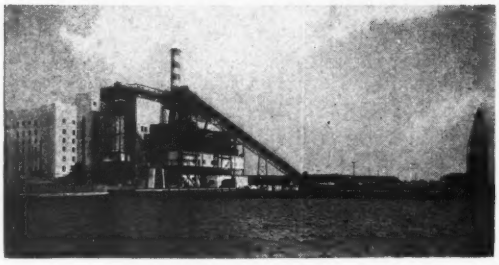

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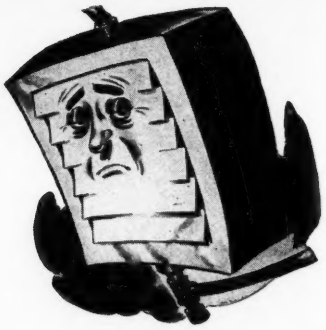
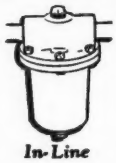
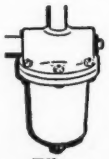


LET SUPER-SILVERTOP
pull the plug on loggy unit heaters



In-Line



Elbow

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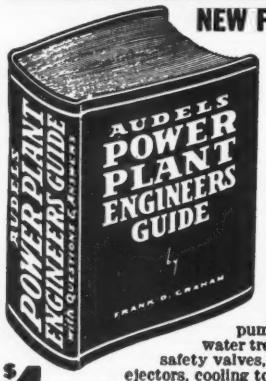

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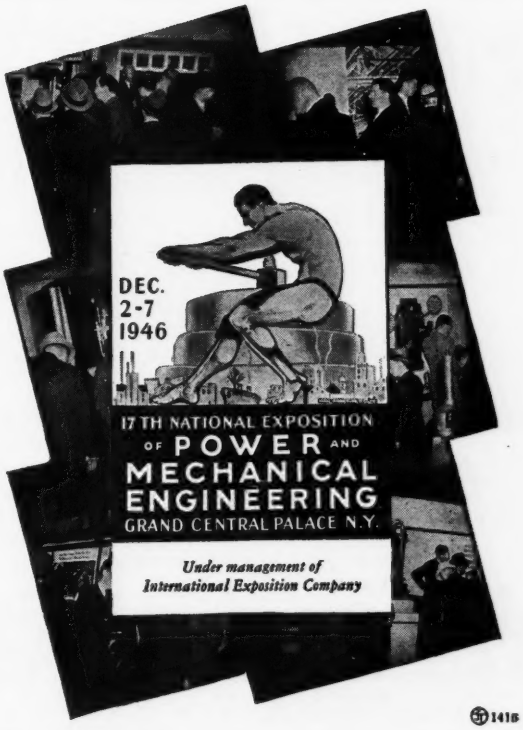

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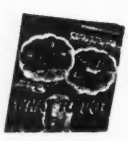

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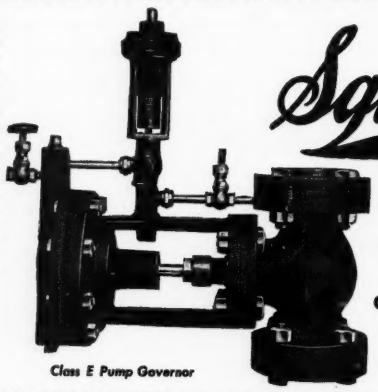

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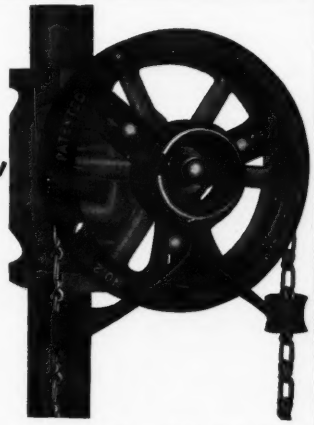

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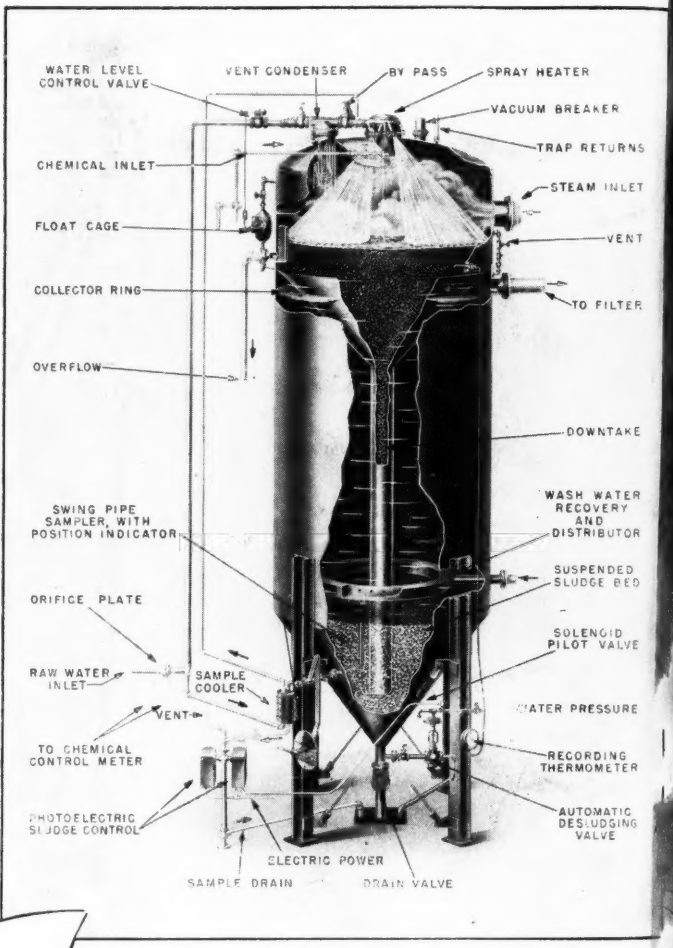

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